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A Glossary of Coastal Engineering Terms

Compiled by
Richard H. Allen

MISCELLANEOUS PAPER 2-72
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U. S. ARMY, CORPS OF ENGINEERS
COASTAL ENGINEERING
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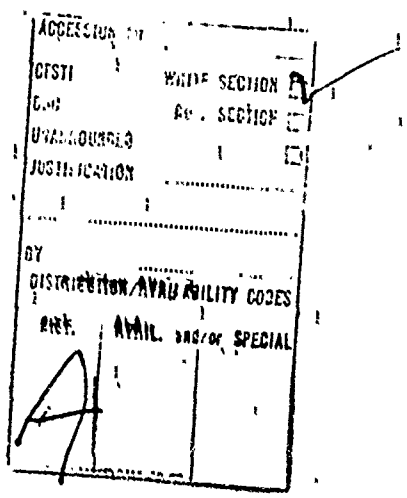

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A glossary of terms used by coastal engineers is presented. The terms apply to such subjects as waves, tides, littoral processes, shore protection, shore structures, and coastal geomorphology. Primary sources are cited.

Details of illustrations in this document may be better studied on microfiche

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III

ABSTRACT

A glossary of terms used by coastal engineers is presented. The terms apply to such subjects as waves, tides, littoral processes, shore protection, shore structures, and coastal geomorphology. Primary sources are cited.

FOREWORD

Shore Protection, Planning and Design, Technical Report No. 4 (TR-4) and its glossary were revised in 1961 (2d edition) and 1966 (3d edition). In preparing the glossary for the first edition of TR-4, a glossary prepared at the University of California by Robert L. Wiegel was of special value. Weigel's glossary was published in July 1953 by the Council on Wave Research, the Engineer Foundation, as *Waves, Tides, Currents, and Beaches: Glossary of Terms and List of Standard Symbols.*

With increased interest in coastal engineering, new terms are being developed and progress toward a more complete and accepted understanding of existing terms is being made. The purpose of this Miscellaneous Paper is to present the latest definitions of terms used in the coastal engineering field. The primary sources used in the compilation of this glossary were:

American Geological Institute (1957) - *Glossary of Geology and Related Sciences with Supplement.* 2d Edition.

American Meteorological Society (1959) - *Glossary of Meteorology.*

U.S. Army Coastal Engineering Research Center (1966) - *Shore Protection, Planning and Design,* Technical Report No. 4. 3d Edition.

U.S. Coast and Geodetic Survey (1949) - *Tide and Current Glossary,* Special Publication No. 228. Revised (1949) Edition.

U.S. Navy Oceanographic Office (1966) - *Glossary of Oceanographic Terms,* Special Publication (SP-35). 2d Edition.

The glossary was compiled by Richard H. Allen, Chief, Publications Branch under the general supervision of George M. Watts, Chief, Engineering Development Division.

The glossary was reviewed by members of the Coastal Engineering Research Board, the Office of the Chief of Engineers, and the U.S. Army Waterways Experiment Station. CERC is grateful for the valuable suggestions provided by these reviewers.

At the time of publication Lieutenant Colonel Don S. McCoy was Director of CERC; Thorndike Saville, Jr. was Technical Director.

NOTE: Comments on this glossary are invited. Readers who find omissions or errors are encouraged to submit their suggestions.

This report is published under authority of Public Law, 79th Congress approved 31 July 1945, as supplemented by Public Law 172, 88th Congress, approved 7 November 1963.

A GLOSSARY OF

COASTAL ENGINEERING TERMS

ACCRETION - May be either NATURAL or ARTIFICIAL. Natural accretion is the buildup of land solely by the action of the forces of nature, on a BEACH by deposition of waterborne or airborne material. Artificial accretion is a similar buildup of land by reason of an act of man, such as the accretion formed by a groin, breakwater, or beach fill deposited by mechanical means. Also AGGRADATION.

ADVANCE (OF A BEACH) - (1) A continuing seaward movement of the shoreline. (2) A net seaward movement of the shoreline over a specified time. Also PROGRESSION.

AGE, WAVE - The ratio of wave velocity to wind velocity (in wave forecasting theory).

AGGRADATION - See ACCRETION

ALLUVIUM - Soil (sand, mud, or similar detrital material) deposited by streams, or the deposits formed.

ALONGSHORE - Parallel to and near the shoreline; same as LONGSHORE.

AMPLITUDE, WAVE - (1) The magnitude of the displacement of a wave from a mean value. An ocean wave has an amplitude equal to the vertical distance from stillwater level to wave crest. For a sinusoidal wave, amplitude is one-half the wave height. (2) The semirange of a constituent tide.

ANTIDUNES - BED FORMS that occur in trains, and are in phase with and strongly interact with gravity water-surface waves.

ANTINODE - See LOOP.

ARTIFICIAL NOURISHMENT - The process of replenishing a beach with material (usually sand) obtained from another location.

ATOLL - A ring-shaped coral reef, often carrying low sand islands, enclosing a lagoon.

ATTENUATION - (1) A lessening of the amplitude of a wave with distance from the origin. (2) The decrease of water-particle motion with increasing depth. Particle motion resulting from surface oscillatory waves attenuates rapidly with depth, and practically disappears at a depth equal to a surface wavelength.

AWASH - Situated so that the top is intermittently washed by waves or tidal action. Condition of being exposed or just bare at any stage of the tide between high water and chart datum.

BACKBEACH - See BACKSHORE.

BACKRUSH - The seaward return of the water following the uprush of the waves. For any given tide stage the point of farthest return seaward of the backrush is known as the LIMIT of BACKRUSH or LIMIT BACKWASH. (See Figure A-2.)

BACKSHORE - That zone of the shore or beach lying between the foreshore and the coastline and acted upon by waves only during severe storms, especially when combined with exceptionally high water. Also BACKBEACH. It comprises the BERM or BERMS. (See Figure A-1.)

BACKWASH - (1) See BACKRUSH. (2) Water or waves thrown back by an obstruction such as a ship, breakwater, or cliff.

BANK - (1) The rising ground bordering a lake, river, or sea; of a river or channel, designated as right or left as it would appear facing downstream. (2) An elevation of the sea floor of large area, located on a Continental (or island) Shelf and over which the depth is relatively shallow but sufficient for safe surface navigation; a group of shoals. (3) In its secondary sense, a shallow area consisting of shifting forms of silt, sand, mud, and gravel, but in this case it is only used with a qualifying word such as "sandbank" or "gravelbank".

BAR - A submerged or emerged embankment of sand, gravel, or other unconsolidated material built on the sea floor in shallow water by waves and currents. See BAYMOUTH BAR, CUSPATE BAR. (See Figures A-2 and A-9.)

BARRIER BEACH - A bar essentially parallel to the shore, the crest of which is above normal high water level. Also called OFFSHORE BARRIER and BARRIER ISLAND. (See Figure A-9.)

BARRIER LAGOON - A bay roughly parallel to the coast and separated from the open ocean by barrier islands. Also the body of water encircled by coral islands and reefs, in which case it may be called an atoll lagoon.

BARRIER REEF - A coral reef parallel to and separated from the coast by a lagoon that is too deep for coral growth. Generally, barrier reefs follow the coasts for long distances, and are cut through at irregular intervals by channels or passes.

BASIN, BOAT - A naturally or artificially enclosed or nearly enclosed harbor area for small craft.

BATHYMETRY - The measurement of depths of water in oceans, seas, and lakes; also information derived from such measurements.

BAY - A recess in the shore or an inlet of a sea between two capes or headlands, not as large as a gulf but larger than a cove. See also BIGHT, EMBAYMENT. (See Figure A-9.)

BAYMOUTH BAR - A bar extending partly or entirely across the mouth of a bay. (See Figure A-9.)

BAYOU - A minor sluggish waterway or estuarial creek, tributary to, or connecting, other streams or bodies of water. Its course is usually through lowlands or swamps. Sometimes called SLOUGH.

BEACH - The zone of unconsolidated material that extends landward from the low water line to the place where there is marked change in material or physiographic form, or to the line of permanent vegetation (usually the effective limit of storm waves). The seaward limit of a beach - unless otherwise specified - is the mean low water line. A beach includes FORESHORE and BACKSHORE. (See Figure A-1.)

BEACH ACCRETION - See ACCRETION.

BEACH BERM - A nearly horizontal part of the beach or backshore formed by the deposit of material by wave action. Some beaches have no berms, others have one or several. (See Figure A-1.)

BEACH CUSP - See CUSP.

BEACH EROSION - The carrying away of beach materials by wave action, tidal currents, littoral currents, or wind.

BEACH FACE - The section of the beach normally exposed to the action of the wave uprush. The FORESHORE of a BEACH. (Not synonymous with SHOREFACE.) (See Figure A-2.)

BEACH RIDGE - See RIDGE, BEACH.

BEACH SCARP - See SCARP, BEACH.

BEACH WIDTH - The horizontal dimension of the beach measured normal to the shoreline.

BED FORMS - Any deviation from a flat bed that is readily detectable by eye, and higher than the largest sediment size present in the parent bed material; generated on the bed of an alluvial channel by the flow.

BEDLOAD - See LOAD.

BENCH - (1) A level or gently sloping erosion plane inclined seaward. (2) A nearly horizontal area at about the level of maximum high water on the sea side of a dike.

BENCH MARK - A permanently fixed point of known elevation. A primary bench mark is one close to a tide station to which the tide staff and tidal datum originally are referenced.

BERM, BEACH - See BEACH BERM.

BERM CREST - The seaward limit of a berm. Also BERM EDGE. (See Figure A-1.)

BIGHT - A bend in a coastline forming an open bay. A bay formed by such a bend. (See Figure A-°.)

BLOWN SANDS - See EOLIAN SANDS.

BLUFF - A high steep bank or cliff.

BOLD COAST - A prominent land mass that rises steeply from the sea.

BORE - A very rapid rise of the tide in which the advancing water presents an abrupt front of considerable height. In shallow estuaries where the range of tide is large, the high water is propagated inward faster than the low water because of the greater depth at high water. If the high water overtakes the low water, an abrupt front is presented with the high water crest finally falling forward as the tide continues to advance. Also EAGER.

BOTTOM - The ground or bed under any body of water; the bottom of the sea. (See Figure A-1.)

BOTTOM (NATURE OF) - The composition or character of the bed of an ocean or other body of water (e.g., clay, coral, gravel, mud, ooze, pebbles, rock, shell, shingle, hard, or soft).

BOULDER - A rounded rock more than 10 inches in diameter; larger than a cobblestone. See SOIL CLASSIFICATION.

BREAKER - A wave breaking on a shore, over a reef, etc. Breakers may be classified into four types (see Figure A-4):

Spilling - bubbles and turbulent water spill down front face of wave. The upper 25 percent of the front face may become vertical before breaking. Breaking generally across over quite a distance.

Plunging - crest curls over air pocket; breaking is usually with a crash. Smooth splash-up usually follows.

Collapsing - breaking occurs over lower half of wave. Minimal air pocket and usually no splash-up. Bubbles and foam present. (See Figure A-12.)

Surging - wave peaks up, but bottom rushes forward from under wave, and wave slides up beach face with little or no bubble production. Water surface remains almost plane except where ripples may be produced on the beachface during runback.

BREAKER DEPTH - The stillwater depth at the point where a wave breaks. Also BREAKING DEPTH. (See Figure A-2.)

BREAKWATER - A structure protecting a shore area, harbor, anchorage, or basin from waves.

BULKHEAD - A structure or partition to retain or prevent sliding of the land. A secondary purpose is to protect the upland against damage from wave action.

BUOY - A float; especially a floating object moored to the bottom, to mark a channel, anchor, shoal, rock, etc.

BUOYANCY - The resultant of upward forces, exerted by the water on a submerged or floating body, equal to the weight of the water displaced by this body.

BYPASSING, SAND - Hydraulic or mechanical movement of sand from the accreting updrift side to the eroding downdrift side of an inlet or harbor entrance. The hydraulic movement may include natural as well as movement caused by man.

CANAL - An artificial watercourse cut through a land area for such uses as navigation and irrigation.

CANYON - A relatively narrow, deep depression with steep slopes, the bottom of which grades continuously downward. May be underwater (submarine) or on land (subaerial).

CAPE - A relatively extensive land area jutting seaward from a continent or large island which prominently marks a change in, or interrupts notably, the coastal trend; a prominent feature. (See Figure A-8.)

CAPILLARY WAVE - A wave whose velocity or propagation is controlled primarily by the surface tension of the liquid in which the wave is traveling. Water waves of length less than about 1 inch are considered capillary waves. Waves longer than 1 inch and shorter than 2 inches are in an indeterminate zone between CAPILLARY and GRAVITY WAVES. See RIPPLE.

CAUSEWAY - A raised road, across wet or marshy ground, or across water.

CAUSTIC - In refraction of waves, the name given to the curve to which adjacent orthogonals of waves refracted by a bottom whose contour lines are curved, are tangents. The occurrence of a caustic always marks a region of crossed orthogonals and high wave convergence.

CAY - See KEY.

CELERITY - Wave speed.

CENTRAL PRESSURE INDEX (CPI) - The estimated minimum barometric pressure in the *eye (approximate center)* of a particular hurricane. The CPI is considered the most stable index to intensity of hurricane wind velocities in the periphery of the storm; the highest wind speeds are associated with storms having the lowest CPI.

CHANNEL - (1) A natural or artificial waterway of perceptible extent which either periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. (2) The part of a body of water deep enough to be used for navigation through an area otherwise too shallow for navigation. (3) A large strait, as the English Channel. (4) The deepest part of a stream, bay, or strait through which the main volume or current of water flows.

CHARACTERISTIC WAVE HEIGHT - See SIGNIFICANT WAVE HEIGHT.

CHART DATUM - The plane or level to which soundings (or elevations) or tide heights are referenced (usually LOW WATER DATUM). The surface is called a tidal datum when referred to a certain phase of tide. To provide a safety factor for navigation, some level lower than MEAN SEA LEVEL is generally selected for hydrographic charts such as MEAN LOW WATER or MEAN LOWER LOW WATER. See DATUM PLANE.

CHOP - The short-crested waves that may spring up quickly in a moderate breeze, and break easily at the crest. Also WIND CHOP.

CLAPOTIS - The French equivalent for a type of STANDING WAVE. In American usage it is usually associated with the standing wave phenomenon caused by the reflection of a nonbreaking wave train from a structure with a face that is vertical or nearly vertical. Full clapotis is one with 100 percent reflection of the incident wave; partial clapotis is one with less than 100 percent reflection.

CLAY - See SOIL CLASSIFICATION.

CLIFF - A high, steep face of rock; a precipice. See also SEA CLIFF.

CNOIDAL WAVE - A type of wave in shallow water (depth of water is less than 1/8 to 1/10 the wavelength). The surface profile is expressed in terms of the Jacobian eliptic function *cn u*; hence the term cnoidal.

COAST - A strip of land of indefinite width (may be several miles) that extends from the shoreline inland to the first major change in terrain features. (See Figure A-1.)

COASTAL AREA - The land and sea area bordering the shoreline. (See Figure A-1.)

COASTAL PLAIN - The plain composed of horizontal or gently sloping strata of clastic materials fronting the coast, and generally representing a strip of sea bottom that has emerged from the sea in recent geologic time.

COASTLINE - (1) Technically, the line that forms the boundary between the COAST and the SHORE. (2) Commonly, the line that forms the boundary between the land and the water.

COBBLE (COBBLESTONE) - See SOIL CLASSIFICATION.

COMBER - (1) A deepwater wave whose crest is pushed forward by a strong wind; much larger than a whitecap. (2) A long-period breaker.

CONTINENTAL SHELF - The zone bordering a continent and extending from the low water line to the depth (usually about 100 fathoms) where there is a marked or rather steep descent toward a greater depth.

CONTOUR - A line on a map or chart representing points of equal elevation with relation to a DATUM. It is called an ISOBATH when connecting points of equal depth below a datum.

CONTROLLING DEPTH - The least depth in the navigable parts of a waterway, governing the maximum draft of vessels that can enter.

CONVERGENCE - (1) In refraction phenomena, the decreasing of the distance between orthogonals in the direction of wave travel. Denotes an area of increasing wave height and energy concentration. (2) In wind-setup phenomena, the increase in setup observed over that which would occur in an equivalent rectangular basin of uniform depth, caused by changes in planform or depth; also the decrease in basin width or depth causing such increase in setup.

CORAL - (1) (Biology) Marine coelenterates (Madreporaria), solitary or colonial, which form a hard external covering of calcium compounds, or other materials. The corals which form large reefs are limited to warm, shallow waters, while those forming solitary, minute growths may be found in colder waters to great depths. (2) (Geology) The concretion of coral polyps, composed almost wholly of calcium carbonate, forming reefs, and tree-like and globular masses. May also include calcareous algae and other organisms producing calcareous secretions, such as bryozoans and hydrozoans.

CORE - A vertical cylindrical sample of the bottom sediments from which the nature and stratification of the bottom may be determined.

COVE - A small, sheltered recess in a coast, often inside a larger embayment. (See Figure A-8.)

CREST LENGTH, WAVE - The length of a wave *along* its crest. Sometimes called CREST WIDTH.

CREST OF BERM - The seaward limit of a berm. Also BERM EDGE. (See Figure A-1.)

CREST OF WAVE - (1) The highest part of a wave. (2) That part of the wave above stillwater level. (See Figure A-3.)

CREST WIDTH, WAVE - See CREST LENGTH, WAVE.

CURRENT - A flow of water.

CURRENT, COASTAL - One of the offshore currents flowing generally parallel to the shoreline in the deeper water beyond and near the surf zone. They are not related genetically to waves and resulting surf, but may be related to tides, winds, or distribution of mass.

CURRENT, DRIFT - A broad, shallow, slow-moving ocean or lake current. Opposite of CURRENT, STREAM.

CURRENT, EBB - The tidal current away from shore or down a tidal stream. Usually associated with the decrease in the height of the tide.

CURRENT, EDDY - See EDDY.

CURRENTS, FEEDER - The parts of the NEARSHORE CURRENT SYSTEM that flow parallel to shore before converging and forming the neck of the RIP CURRENT.

CURRENT, FLOOD - The tidal current toward shore or up a tidal stream. Usually associated with the increase in the height of the tide.

CURRENT, INSHORE - See INSHORE CURRENT.

CURRENT, LITTORAL - Any current in the littoral zone caused primarily by wave action, e.g., longshore current, rip current. See also CURRENT, NEARSHORE.

CURRENT, LONGSHORE - The littoral current in the breaker zone moving essentially parallel to the shore, usually generated by waves breaking at an angle to the shoreline.

CURRENT, NEARSHORE - A current in the NEARSHORE ZONE. See Figure A-1.

CURRENT, OFFSHORE - See OFFSHORE CURRENT.

CURRENT, PERIODIC - See CURRENT, TIDAL.

CURRENT, PERMANENT - See PERMANENT CURRENT.

CURRENT, RIP - See RIP CURRENT.

CURRENT, STREAM - A narrow, deep, and swift ocean current, as the Gulf Stream. Opposite of CURRENT, DRIFT.

CURRENT SYSTEM, NEARSHORE - See NEARSHORE CURRENT SYSTEM.

CURRENT, TIDAL - The alternating horizontal movement of water associated with the rise and fall of the tide caused by the astronomical tide-producing forces. Also CURRENT, PERIODIC. See also CURRENT, FLOOD and CURRENT, EBB.

CUSP - One of a series of low mounds of beach material separated by crescent-shaped troughs spaced at more or less regular intervals along the beach face. Also BEACH CUSP. (See Figure A-7.)

CUSPATE BAR - A crescent-shaped bar uniting with the shore at each end. It may be formed by a single spit growing from shore and then turning back to again meet the shore, or by two spits growing from the shore and uniting to form a bar of sharply cuspate form. (See Figure A-9.)

CYCLOIDAL WAVE - A steep, symmetrical wave whose crest forms an angle of 120 degrees. The wave form is that of a cycloid. A trochoidal wave of maximum steepness. See also TROCHOIDAL WAVE.

DAILY RETARDATION (OF TIDES) - The amount of time by which corresponding tidal phases grow later day by day (about 50 minutes).

DATUM, CHART - See CHART DATUM.

DATUM, PLANE - The horizontal plane to which soundings, ground elevations, or water surface elevations are referred. Also REFERENCE PLANE. The plane is called a TIDAL DATUM when defined by a certain phase of the tide. The following datums are ordinarily used on hydrographic charts:

MEAN LOW WATER - Atlantic coast (U. S.), Argentina, Sweden, and Norway;
MEAN LOWER LOW WATER - Pacific coast (U. S.);
MEAN LOW WATER SPRINGS - United Kingdom, Germany, Italy, Brazil, and Chile;
LOW WATER DATUM - Great Lakes (U. S. and Canada);
LOWEST LOW WATER SPRINGS - Portugal;
LOW WATER INDIAN SPRINGS - India and Japan (See INDIAN TIDE PLANE);
LOWEST LOW WATER - France, Spain, and Greece.

A common datum used on topographic maps is based on MEAN SEA LEVEL. See also BENCH MARK.

DEBRIS LINE - A line near the limit of storm wave uprush marking the landward limit of debris deposits.

DECAY DISTANCE - The distance waves travel after leaving the generating area (FETCH).

DECAY OF WAVES - The change waves undergo after they leave a generating area (FETCH) and pass through a calm, or region of lighter winds. In the process of decay, the significant wave height decreases and the significant wavelength increases.

DEEP WATER - Water so deep that surface waves are little affected by the ocear bottom. Generally, water deeper than one-half the surface wavelength is considered deep water.

DEFLATION - The removal of loose material from a beac. or other land surface by wind action.

DELTA - An alluvial deposit, roughly triangular or digitate in shape, formed at a river mouth.

DEPTH - The vertical distance from a specified tidal datum to the sea floor.

DEPTH OF BREAKING - The stillwater depth at the point where the wave breaks. Also BREAKER DEPTH (See Figure A-2.)

DEPTH CONTOUR - See CONTOUR.

DEPTH, CONTROLLING - See CONTROLLING DEPTH.

DEPTH FACTOR - See SHOALING COEFFICIENT.

DERRICK STONE - See STONE, DERRICK.

DESIGN HURRICANE - See HYPOTHETICAL HURRICANE.

DIFFRACTION (of water waves) - The phenomenon by which energy is transmitted laterally along a wave crest. When a part of a train of waves is interrupted by a barrier, such as a breakwater, the effect of diffraction is manifested by propagation of waves into the sheltered region within the barrier's geometric shadow.

DIKE(DYKE) - A wall or mound built around a low-lying area to prevent flooding.

DIURNAL - Having a period or cycle of approximately one TIDAL DAY.

DIURNAL TIDE - A tide with one high water and one low water in a tidal day. (See Figure A-10.)

DIVERGENCE - (1) In refraction phenomena, the increasing of distance between orthogonals in the direction of wave travel. Denotes an area of decreasing wave height and energy concentration. (2) In wind-setup phenomena, the decrease in setup observed under that which would occur in an equivalent rectangular basin of uniform depth, caused by changes in planform or depth. Also the increase in basin width or depth causing such decrease in setup.

DOLPHIN - A cluster of piles.

DOWNCOAST - In United States usage, the coastal direction generally trending toward the south.

DOWNDRIFT - The direction of predominant movement of littoral materials.

DRIFT (noun) - (1) Sometimes used as a short form for LITTORAL DRIFT (2) The speed at which a current runs (3) Also floating material deposited on a beach (driftwood). (4) A deposit of a continental ice sheet, as a drumlin.

DRIFT CURRENT - A broad, shallow, slow-moving ocean or lake current.

DUNES - (1) Ridges or mounds of loose, wind-blown material, usually sand. (See Figure A-7.) (2) BED FORMS smaller than bars but larger than ripples that are out of phase with any water-surface gravity waves associated with them.

DURATION - In wave forecasting, the length of time the wind blows in nearly the same direction over the FETCH (generating area).

DURATION, MINIMUM - The time necessary for steady-state wave conditions to develop for a given wind velocity over a given fetch length.

EAGER - See BORE.

Eb CURRENT - The tidal current away from shore or up a tidal stream; usually associated with the decrease in the height of the tide.

EBB TIDE - The period of tide between high water and the succeeding low water; a falling tide. (See Figure A-10.)

ECHO SOUNDER - An electronic instrument used to determine the depth of water by measuring the time interval between emission of a sonic or ultrasonic signal and the return of its echo from the bottom.

EDDY - A circular movement of water formed on the side of a main current. Eddies may be created at points where the main stream passes projecting obstructions or where two adjacent currents flow counter to each other.

EDDY CURRENT - See EDDY.

EDGE WAVE - An ocean wave parallel to a coast, with crests normal to the shoreline. An edge wave may be standing or progressive. Its height diminishes rapidly seaward and is negligible at a distance of one wavelength offshore.

EMBANKMENT - An artificial bank such as a mound or dike, generally built to hold back water or to carry a roadway.

EMBAYED - Formed into a bay or bays, as an embayed shore.

EMBAYMENT - An indentation in the shoreline forming an open bay.

ENERGY COEFFICIENT - The ratio of the energy in a wave per unit crest length transmitted forward with the wave at a point in shallow water to the energy in a wave per unit crest length transmitted forward with the wave in deep water. On refraction diagrams this is equal to the ratio of the distance between a pair of orthogonals at a selected point to the distance between the same pair of orthogonals in deep water. Also the square of the REFRACTION COEFFICIENT.

ENTRANCE - The avenue of access or opening to a navigable channel.

EOLIAN SANDS - (or BLOWN SANDS) - Sediments of sand size or smaller which have been transported by winds. They may be recognized in marine deposits off desert coasts by the greater angularity of the grains compared with waterborne particles.

EROSION - The wearing away of land by the action of natural forces. On a beach, the carrying away of beach material by wave action, tidal currents, littoral currents, or by deflation.

ESCARPMENT - A more or less continuous line of cliffs or steep slopes facing in one general direction which are caused by erosion or faulting. Also SCARP. (See Figure A-1.)

ESTUARY - (1) The part of a river that is affected by tides. (2) The region near a river mouth in which the fresh water of the river mixes with the salt water of the sea.

EYE - In meteorology, usually the "eye of the storm" (hurricane); the roughly circular area of comparatively light winds and fair weather found at the center of a severe tropical cyclone.

FAIRWAY - The parts of a waterway that are open and unobstructed for navigation. The main traveled part of a waterway; a marine thoroughfare.

FATHOM - A unit of measurement used for soundings. It is equal to 6 feet (1.83 meters).

FATHOMETER - The copyrighted trademark for a type of echo sounder.

FEEDER BEACH - An artificially widened beach serving to nourish downdrift beaches by natural littoral currents or forces.

FEEDER CURRENT - See CURRENT, FEEDER.

FEELING BOTTOM - The action of a deepwater wave on running into shoal water and beginning to be influenced by the bottom.

FETCH - The area in which SEAS are generated by a wind having a rather constant direction and speed. Sometimes used synonymously with FETCH LENGTH. Also GENERATING AREA.

FETCH LENGTH - The horizontal distance (in the direction of the wind) over which a wind generates SEAS or creates a WIND SETUP.

FIRTH - A narrow arm of the sea; also the opening of a river into the sea.

FIORD (FJORD) - A narrow, deep, steep-walled inlet of the sea, usually formed by entrance of the sea into a deep glacial trough.

FLOOD CURRENT - The tidal current toward shore or up a tidal stream, usually associated with the increase in the height of the tide.

FLOOD TIDE - The period of tide between low water and the succeeding high water; a rising tide. (See Figure A-10.)

FOAM LINE - The front of a wave as it advances shoreward, after it has broken. (See Figure A-4.)

FOLLOWING WIND - Generally, same as tailwind; in wave forecasting, wind blowing in the direction of ocean-wave advance.

FOREDUNE - The front dune immediately behind the backshore.

FORERUNNER - Low, long-period ocean SWELL which commonly precedes the main swell from a distant storm, especially a tropical cyclone.

FORESHORE - The part of the shore lying between the crest of the seaward berm (or upper limit of wave wash at high tide) and the ordinary low water mark, that is ordinarily traversed by the uprush and backrush of the waves as the tides rise and fall. See BEACH FACE. (See Figure A-1.)

FORWARD SPEED (HURRICANE) - Rate of movement (propagation) of the hurricane eye in mph or knots.

FREEBOARD - The additional height of a structure above design high water level to prevent overflow. Also, at a given time, the vertical distance between the water level and the top of the structure. On a ship, the distance from the water line to main deck or gunwale.

FRINGING REEF - A coral reef attached directly to an insular or continental shore.

FRONT OF THE FETCH - In wave forecasting, the end of the generating area toward which the wind is blowing.

FROUDE NUMBER - The dimensionless ratio of the inertial force to the force of gravity for a given fluid flow. It may be given as $Fr = V^2/Lg$ where V is a characteristic velocity, L is a characteristic length, and g the acceleration of gravity; or as the square root of this number.

GENERATING AREA - In wave forecasting, the continuous area of water surface over which the wind blows in nearly a constant direction. Sometimes used synonymously with FETCH LENGTH. Also FETCH.

GENERATION OF WAVES - (1) The creation of waves by natural or mechanical means. (2) The creation and growth of waves caused by a wind blowing over a water surface for a certain period of time. The area involved is called the GENERATING AREA or FETCH.

GEOMETRIC MEAN DIAMETER - The diameter equivalent of the arithmetic mean of the logarithmic frequency distribution. In the analysis of beach sands, it is taken as that grain diameter determined graphically by the intersection of a straight line through selected boundary sizes, (generally points on the distribution curve where 16 and 84 percent of the sample is coarser by weight) and a vertical line through the median diameter of the sample.

GEOMETRIC SHADOW - In wave diffraction theory, the area outlined by drawing straight lines paralleling the direction of wave approach through the extremities of the protective structure. It differs from the actual protected area to the extent that the diffraction and refraction effects modify the wave pattern.

GEOMORPHOLOGY - That branch of both physiography and geology which deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of land forms.

GRADIENT (GRADE) - See SLOPE. With reference to winds or currents, the rate of increase or decrease in speed, usually in the vertical; or the curve that represents this rate.

GRAVEL - See SOIL CLASSIFICATION.

GRAVITY WAVE - A wave whose velocity of propagation is controlled primarily by gravity. Water waves more than 2 inches long are considered gravity waves. Waves longer than 1 inch and shorter than 2 inches are in an indeterminate zone between CAPILLARY and GRAVITY WAVES. See RIPPLE.

GROIN (British, GROYNE) - A shore protection structure built (usually perpendicular to the shoreline) to trap littoral drift or retard erosion of the shore.

GROIN SYSTEM - A series of groins acting together to protect a section of beach. Commonly called a groin field.

GROUND SWELL - A long high ocean swell; also, this swell as it rises to prominent height in shallow water.

GROUND WATER - Subsurface water occupying the zone of saturation. In a strict sense, the term is applied only to water below the WATER TABLE.

GROUP VELOCITY - The velocity of a wave group. In deep water, it is equal to one-half the velocity of the individual waves within the group.

GULF - A large embayment in a coast; the entrance is generally wider than the length.

GUT - (1) A narrow passage such as a strait or inlet. (2) A channel in otherwise shallower water, generally formed by water in motion.

HALF-TIDE LEVEL - MEAN TIDE LEVEL.

HARBOR (British, HARBOUR) - Any protected water area affording a place of safety for vessels. See also PORT.

HARBOR OSCILLATION (Harbor Surging) - The nontidal vertical water movement in a harbor or bay. Usually the vertical motions are low, but when oscillations are excited by a tsunami or storm surge, they may be quite large. Variable winds, air oscillations, or surf beat also may cause oscillations. See SEICHE.

HEADLAND (HEAD) - A high steep-faced promontory extending into the sea.

HEAD OF RIP - The part of a rip current that has widened out seaward of the breakers. See also CURRENT, RIP; CURRENT, FEEDER; and NECK (RIP).

HEIGHT OF WAVE - See WAVE HEIGHT.

HIGH TIDE, HIGH WATER (HW) - The maximum elevation reached by each rising tide. See TIDE. (See Figure A-10.)

HIGH WATER OF ORDINARY SPRING TIDES (HWOST) - A tidal datum appearing in some British publications, based on high water of ordinary spring tides.

HIGHER HIGH WATER (HHW) - The higher of the two high waters of any tidal day. The single high water occurring daily during periods when the tide is diurnal is considered to be a higher high water. (See Figure A-10.)

HIGHER LOW WATER (HLW) - The higher of two low waters of any tidal day. (See Figure A-10.)

HIGH WATER - See HIGH TIDE.

HIGH WATER LINE - In strictness, the intersection of the plane of mean high water with the shore. The shoreline delineated on the nautical charts of the U. S. Coast and Geodetic Survey is an approximation of the high water line. For specific occurrences, the highest elevation on the shore reached during a storm or rising tide, including meteorological effects.

HINDCASTING, WAVE - The use of historic synoptic wind charts to calculate wave characteristics that probably occurred at some past time.

HOOK - A spit or narrow cape of sand or gravel which turns landward at the outer end.

HURRICANE - An intense tropical cyclone in which winds tend to spiral inward toward a core of low pressure, with maximum surface wind velocities that equal or exceed 75 mph (65 knots) for several minutes or longer at some points. TROPICAL STORM is the term applied if maximum winds are less than 75 mph.

HURRICANE PATH OR TRACK - Line of movement (propagation) of the eye through an area.

HURRICANE STAGE HYDROGRAPH - A continuous graph representing water level stages that would be recorded in a gage well located at a specified point of interest during the passage of a particular hurricane, assuming that effects of relatively short-period waves are eliminated from the record by damping features of the gage well. Unless specifically excluded and separately accounted for, hurricane surge hydrographs are assumed to include effects of astronomical tides, barometric pressure differences, and all other factors that influence water level stages within a properly designed gage well located at a specified point.

HURRICANE SURGE HYDROGRAPH - A continuous graph representing the difference between the hurricane stage hydrograph and the water stage hydrograph that would have prevailed at the same point and time if the hurricane had not occurred.

HURRICANE WIND PATTERN or ISOVEL PATTERNS - An actual or graphical representation of near-surface wind velocities covering the entire area of a hurricane at a particular instant. Isovels are lines connecting points of simultaneous equal wind velocities, usually referenced 30 feet above the surface, in knots or mph; wind directions at various points are indicated by arrows or deflection angles on the isovel charts. Isovel charts are usually prepared at each hour during a hurricane, but for each half hour during critical periods.

HYDRAULICALLY EQUIVALENT GRAINS - Sedimentary particles that settle at the same rate under the same conditions.

HYDROGRAPHY - (1) A configuration of an underwater surface including its relief, bottom materials, coastal structures, etc. (2) The description and study of seas, lakes, rivers, and other waters.

HYPOTHETICAL HURRICANE ("HYPO-HURRICANE") - A representation of a hurricane, with specified characteristics, that is assumed to occur in a particular study area, following a specified path and timing sequence.

TRANSPOSED - A hypo-hurricane based on the storm transposition principle is assumed to have wind patterns and other characteristics basically comparable to a specified hurricane of record, but is *transposed* to follow a new path to serve as a basis for computing a hurricane surge hydrograph that would be expected at a selected point. Moderate adjustments in timing or rate of forward movement may be made also. if these are compatible with meteorological considerations and study objectives.

HYPO-HURRICANE BASED ON GENERALIZED PARAMETERS - Hypo-hurricane estimates based on various logical combinations of hurricane characteristics used in estimating hurricane surge magnitudes corresponding to a range of probabilities and potentialities. The *Standard Project Hurricane* (SPH) is most commonly used for this purpose, but estimates corresponding to more severe or less severe assumptions are important in some project investigations.

STANDARD PROJECT HURRICANE (SPH) - A hypothetical hurricane intended to represent the most severe combination of hurricane parameters that is *reasonably characteristic* of a specified region, excluding extremely rare combinations. It is further assumed that the SPH would approach a given project site from such direction, and at such rate of movement as to produce the highest hurricane surge hydrograph, considering pertinent hydraulic characteristics of the area. Based on this concept, and extensive meteorological studies and probability analyses, a tabulation of "Standard Project Hurricane Index Characteristics" mutually agreed upon by representatives of the U. S. Weather Bureau and the Corps of Engineers, is available.

PROBABLE MAXIMUM HURRICANE - A hypo-hurricane that might result from the most severe combination of hurricane parameters that is considered reasonably possible in the region involved, if the hurricane should approach the point under study along a critical path and at optimum rate of movement. This estimate is substantially more severe than the SPH criteria.

DESIGN HURRICANE - A representation of a hurricane with specified characteristics that would produce hurricane surge hydrographs and coincident wave effects at various key locations along a proposed project alinement. It governs the project design after economics and other factors have been duly considered. The design hurricane may be more or less severe than the SPH, depending on economics, risk, and local considerations.

IMPERMEABLE GROIN - A groin through which sand cannot pass.

INDIAN SPRING LOW WATER - The approximate level of the mean of lower low waters at spring tides, used principally in the Indian Ocean and along the east coast of Asia. Also INDIAN TIDE PLANE.

INDIAN TIDE PLANE - The datum of INDIAN SPRING LOW WATER.

INLET - (1) A short, narrow waterway connecting a bay, lagoon, or similar body of water with a large parent body of water. (2) An arm of the sea (or other other body of water); that is long compared to its width, and may extend a considerable distance inland. See also TIDAL INLET.

INLET GORGE - Generally, the deepest region of an inlet channel.

INSHORE (ZONE) - In beach terminology, the zone of variable width extending from the low water line through the breaker zone. SHOREFACE. (See Figure A-1.)

INSHORE CURRENT - Any current in or landward of the breaker zone.

INSULAR SHELF - The zone surrounding an island extending from the low water line to the depth (usually about 100 fathoms) where there is a marked or rather steep descent toward the great depths.

INTERNAL WAVES - Waves that occur within a fluid whose density changes with depth, either abruptly at a sharp surface of discontinuity (an interface) or gradually. Their amplitude is greatest at the density discontinuity or, in the case of a gradual density change, somewhere in the interior of the fluid and not at the free upper surface where the surface waves have their maximum amplitude.

IRROTATIONAL WAVE - A wave with fluid particles that do not revolve around an axis through their centers, although the particles themselves may travel in circular or nearly circular orbits. Irrotational waves may be progressive, standing, oscillatory, or translatory. For example, the Airy, Stokes, cnoidal and solitary wave theories describe irrotational waves. See TROCHOIDAL WAVE.

ISOBATH - A contour line connecting points of equal water depths on a chart.

ISOVEL PATTERN - See HURRICANE WIND PATTERN.

ISTHMUS - A narrow strip of land, bordered on both sides by water, that connects two larger bodies of land.

JET - To place (as a pile, slab, or pipe) in the ground by means of a jet of water acting at the lower end.

JETTY - (1) (U. S. usage) On open seacoasts, a structure extending into a body of water, and designed to prevent shoaling of a channel by littoral materials, and to direct and confine the stream or tidal flow. Jetties are built at the mouth of a river or tidal inlet to help deepen and stabilize a channel. (2) (British usage) Jetty is synonymous with "wharf" or "pier". See TRAINING WALL.

KEY - A low insular bank of sand, coral, etc., as one of the islets off the southern coast of Florida, also CAY.

KINETIC ENERGY (OF WAVES) - In a progressive oscillatory wave, a summation of the energy of motion of the particles within the wave.

KNOLL - A submerged elevation of rounded shape rising less than 1,000 meters from the ocean floor, and of limited extent across the summit. See SEAMOUNT.

KNOT - The unit of speed used in navigation. It is equal to 1 nautical mile (6,076.115 feet or 1,852 meters) per hour.

LAGGING - See DAILY RETARDATION (OF TIDES).

LAGOON - A shallow body of water, as a pond or lake, usually connected to the sea. (See Figures A-8 and A-9.)

LAND BREEZE - A light wind blowing from the land to the sea caused by unequal cooling of land and water masses.

LAND-SEA BREEZE - The combination of a land breeze and a sea breeze as a diurnal phenomenon.

LANDLOCKED - An area of water enclosed, or nearly enclosed, by land, as a bay or a harbor (thus, protected from the sea).

LANDMARK - A conspicuous object natural or artificial, located near or on land which aids in fixing the position of an observer.

LEADLINE - A line, wire, or cord used in sounding. It is weighted at one end with a plummet (sounding lead). Also SOUNDING LINE.

LEE - (1) Shelter, or the part or side sheltered or turned away from the wind or waves. (2) (Chiefly nautical) The quarter or region toward which the wind blows.

LEEWARD - The direction *toward* which the wind is blowing; the direction toward which waves are traveling.

LENGTH OF WAVE - The horizontal distance between similar points on two successive waves measured perpendicularly to the crest. (See Figure A-3.)

LEVEE - A dike or embankment to protect land from inundation.

LIMIT OF BACKRUSH, LIMIT OF BACKWASH - See BACKWASH.

LITTORAL - Of or pertaining to a shore, especially of the sea.

LITTORAL CURRENT - See CURRENT, LITTORAL.

LITTORAL DEPOSITS - Deposits of littoral drift.

LITTORAL DRIFT - The sedimentary *material* moved in the littoral zone under the influence of waves and currents.

LITTORAL TRANSPORT - The *movement* of littoral drift in the littoral zone by waves and currents. Includes movement parallel (longshore transport) and perpendicular (on-offshore transport) to the shore.

LITTORAL TRANSPORT RATE - Rate of transport of sedimentary material parallel to or perpendicular to the shore in the littoral zone. Usually expressed in cubic yards (meters) per year. Commonly used as synonymous with LONGSHORE TRANSPORT RATE.

LITTORAL ZONE - In beach terminology, an indefinite zone extending seaward from the shoreline to just beyond the breaker zone.

LOAD - The quantity of sediment transported by a current. It includes the suspended load of small particles, and the bedload of large particles that move along the bottom.

LONGSHORE - Parallel to and near the shoreline.

LONGSHORE BAR - A bar running roughly parallel to the shoreline.

LONGSHORE CURRENT - See CURRENT, LONGSHORE.

LONGSHORE TRANSPORT RATE - Rate of transport of sedimentary material parallel to the shore. Usually expressed in cubic yards (meters) per year. Commonly used as synonymous with LITTORAL TRANSPORT RATE.

LOOP - That part of a STANDING WAVE where the vertical motion is greatest and the horizontal velocities are least. LOOPS (sometimes called ANTINODES) are associated with CLAPOTIS, and with SEICHE action resulting from wave reflections. (See also NODE.)

LOWER HIGH WATER (LHW) - The lower of the two high waters of any tidal day. (See Figure A-10.)

LOWER LOW WATER (LLW) - The lower of the two low waters of any tidal day. The single low water occurring daily during periods when the tide is diurnal is considered to be a lower low water. (See Figure A-10.)

LOW TIDE (LOW WATER, LW) - The minimum elevation reached by each falling tide. See TIDE. (See Figure A-10.)

LOW WATER DATUM - An approximation to the plane of mean low water that has been adopted as a standard reference plane. See also DATUM PLANE and CHART DATUM.

LOW WATER LINE - The intersection of any standard low tide datum plane with the shore.

LOW WATER OF ORDINARY SPRING TIDES (LWOST) - A tidal datum appearing in some British publications, based on low water of ordinary spring tides.

MANGROVE - A tropical tree with interlacing prop roots, confined to low-lying brackish areas.

MARIGRAM - A graphic record of the rise and fall of the tide.

MARSH - An area of soft, wet, or periodically inundated land, generally treeless and usually characterized by grasses and other low growth.

MARSH, SALT - A marsh periodically flooded by salt water.

MASS TRANSPORT - The net transfer of water by wave action in the direction of wave travel. See ORBIT.

MEAN DIAMETER, GEOMETRIC - See GEOMETRIC MEAN DIAMETER.

MEAN HIGHER HIGH WATER (MHHW) - The average height of the higher high waters over a 19-year period. For shorter periods of observation, corrections are applied to eliminate known variations and reduce the result to the equivalent of a mean 19-year value.

MEAN HIGH WATER (MHW) - The average height of the high waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value. All high water heights are included in the average where the type of tide is either semidiurnal or mixed. Only the higher high water heights are included in the average where the type of tide is diurnal. So determined, mean high water in the latter case is the same as mean higher high water.

MEAN HIGH WATER SPRINGS - The average height of the high waters occurring at the time of spring tide. Frequently abbreviated to HIGH WATER SPRINGS.

MEAN LOWER LOW WATER (MLLW) - The average height of the lower low waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value. Frequently abbreviated to LOWER LOW WATER.

MEAN LOW WATER (MLW) - The average height of the low waters over a 19-year period. For shorter periods of observations, corrections are applied to eliminate known variations and reduce the results to the equivalent of a mean 19-year value. All low water heights are included in the average where the type of tide is either semidiurnal or mixed. Only lower low water heights are included in the average where the type of tide is diurnal. So determined, mean low water in the latter case is the same as mean lower low water.

MEAN LOW WATER SPRINGS - The average height of low waters occurring at the time of the spring tides. It is usually derived by taking a plane depressed below the half-tide level by an amount equal to one-half the spring range of tide, necessary corrections being applied to reduce the result to a mean value. This plane is used to a considerable extent for hydrographic work outside of the United States and is the plane of reference for the Pacific approaches to the Panama Canal. Frequently abbreviated to LOW WATER SPRINGS.

MEAN SEA LEVEL - The average height of the surface of the sea for all stages of the tide over a 19-year period, usually determined from hourly height readings. Not necessarily equal to MEAN TIDE LEVEL.

MEAN TIDE LEVEL - A plane midway between MEAN HIGH WATER AND MEAN LOW WATER. Not necessarily equal to MEAN SEA LEVEL. Also called HALF-TIDE LEVEL.

MEDIAN DIAMETER - The diameter which marks the division of a given sand sample into two equal parts by weight, one part containing all grains larger than that diameter and the other part containing grains smaller.

MEGARIPPLE - See SAND WAVE.

MIDDLEGROUND SHOAL - A shoal formed by ebb and flood tides in the middle of the channel of the lagoon or estuary end of an inlet.

MINIMUM DURATION - See DURATION, MINIMUM.

MINIMUM FETCH - The least distance in which steady state wave conditions will develop for a wind of given speed blowing a given duration of time.

MIXED TIDE - A type of tide in which the presence of a diurnal wave is conspicuous by a large inequality in either the high- or low-water heights with two high waters and two low waters usually occurring each tidal day. In strictness, all tides are mixed, but the name is usually applied without definite limits to the tide intermediate to those predominantly semidiurnal and those predominantly diurnal. (See Figure A-10.)

MOLE - In coastal terminology, a massive land-connected, solid-fill structure of earth (generally revetted), masonry, or large stone. It may serve as a breakwater or pier.

MONOCHROMATIC WAVES - A series of waves generated in a laboratory; each wave has the same length and period.

MONOLITHIC - Like a single stone or block. In coastal structures, the type of construction in which the structure's component parts are bound together to act as one.

MUD - A fluid-to-plastic mixture of finely divided particles of solid material and water.

NAUTICAL MILE - The length of a minute of arc, 1/21,600 of an average great circle of the earth. Generally one minute of latitude is considered equal to one nautical mile. The accepted United States value as of 1 July 1959 is 6,076.115 feet or 1,852 meters, approximately 1.15 times as long as the statute mile of 5,280 feet. Also geographical mile.

NEAP TIDE - A tide occurring near the time of quadrature of the moon with the sun. The neap tidal range is usually 10 to 30 percent less than the mean tidal range.

NEARSHORE (ZONE) - In beach terminology an indefinite zone extending seaward from the shoreline well beyond the breaker zone. It defines the area of NEARSHORE CURRENTS. (See Figure A-1.)

NEARSHORE CIRCULATION - The ocean circulation pattern composed of the CURRENTS, NEARSHORE and CURRENTS, COASTAL. See CURRENT.

NEARSHORE CURRENT SYSTEM - The current system caused primarily by wave action in and near the breaker zone, and which consists of four parts: The shoreward mass transport of water; longshore currents; seaward return flow, including rip currents; and the longshore movement of the expanding heads of rip currents. (See Figure A-7.) See also NEARSHORE CIRCULATION.

NECK - (1) The narrow band of water flowing seaward through the surf. Also RIP. (2) The narrow strip of land connecting two larger bodies of land, as an isthmus.

NIP - The cut made by waves in a shoreline of emergence.

NODAL ZONE - An area in which the predominant direction of the LONGSHORE TRANSPORT changes.

NODE - That part of a STANDING WAVE where the vertical motion is least and the horizontal velocities are greatest. Nodes are associated with CLAPOTIS and with SEICHE action resulting from wave reflections. See also LOOP.

NOURISHMENT - The process of replenishing a beach. It may be brought about naturally, by longshore transport, or artificially by the deposition of dredged materials.

OCEANOGRAPHY - The study of the sea, embracing and indicating all knowledge pertaining to the sea's physical boundaries, the chemistry and physics of sea water, and marine biology.

OFFSHORE - (1) In beach terminology, the comparatively flat zone of variable width, extending from the breaker zone to the seaward edge of the Continental Shelf. (2) A direction seaward from the shore. (See Figure A-1.)

OFFSHORE BARRIER - See BARRIER BEACH.

OFFSHORE CURRENT - (1) Any current in the offshore zone. (2) Any current flowing away from shore.

OFFSHORE WIND - A wind blowing seaward from the land in the coastal area.

ONSHORE - A direction landward from the sea.

ONSHORE WIND - A wind blowing landward from the sea in the coastal area.

OPPOSING WIND - In wave forecasting, a wind blowing in a direction opposite to the ocean-wave advance; generally, same as headwind.

ORBIT - In water waves, the path of a water particle affected by the wave motion. In deepwater waves the orbit is nearly circular and in shallow-water waves the orbit is nearly elliptical. In general, the orbits are slightly open in the direction of wave motion giving rise to MASS TRANSPORT. (See Figure A-3.)

ORBITAL CURRENT - The flow of water accompanying the orbital movement of the water particles in a wave. Not to be confused with wave-generated LITTORAL CURRENTS. (See Figure A-3.)

ORTHOGONAL - On a wave-refraction diagram, a line drawn perpendicularly to the wave crests. (See Figure A-6.)

OSCILLATION - A periodic motion backward and forward. To vibrate or vary above and below a mean value.

OSCILLATORY WAVE - A wave in which each individual particle oscillates about a point with little or no permanent change in mean position. The term is commonly applied to progressive oscillatory waves in which only the form advances, the individual particles moving in closed or nearly closed orbits. Distinguished from a WAVE OF TRANSLATION. See also ORBIT.

OUTFALL - A structure extending into a body of water for the purpose of discharging sewage, storm runoff, or cooling water.

OVERTOPPING - Passing of water over the top of a structure as a result of wave runup or surge action.

OVERWASH - That portion of the uprush that carries over the crest of a berm or of a structure.

PARAPET - A low wall built along the edge of a structure as on a seawall or quay.

PARTICLE VELOCITY - The velocity induced by wave motion with which a specific water particle moves within a wave.

PASS - In hydrographic usage, a navigable channel through a bar, reef, or shoal, or between closely adjacent islands.

PEBBLES - See SOIL CLASSIFICATION.

PENINSULA - An elongated body of land nearly surrounded by water, and connected to a larger body of land.

PERCHED BEACH - A beach or fillet of sand retained above the otherwise normal profile level by a submerged dike.

PERCOLATION - The process by which water flows through the interstices of a sediment. Specifically, in wave phenomena, the process by which wave action forces water through the interstices of the bottom sediment. Tends to reduce wave heights.

PERIODIC CURRENT - A current caused by the tide-producing forces of the moon and the sun, a part of the same general movement of the sea that is manifested in the vertical rise and fall of the tides. See also CURRENT, FLOOD and CURRENT, EBB.

PERMANENT CURRENT - A current that runs continuously, independent of the tides and temporary causes. Permanent currents include the fresh-water discharge of a river and the currents that form the general circulatory systems of the oceans.

PERMEABLE GROIN - A groin with openings large enough to permit passage of appreciable quantities of littoral drift.

PETROGRAPHY - The systematic description and classification of rocks.

PHASE - In surface wave motion, a point in the period to which the wave motion has advanced with respect to a given initial reference point.

PHASE INEQUALITY - Variations in the tides or tidal currents associated with changes in the phase of the moon in relation to the sun.

PHASE VELOCITY - Propagation velocity of an individual wave as opposed to the velocity of a wave group.

PHI GRADE SCALE - A logarithmic transformation of the Wentworth grade scale for size classifications of sediment grains based on the negative logarithm to the base 2 of the particle diameter. $\phi = -\log_2 d$. See SOIL CLASSIFICATION.

PIER - A structure, usually of open construction, extending out into the water from the shore, to serve as a landing place, a recreational facility, etc., rather than to afford coastal protection. In the Great Lakes, a term sometimes improperly applied to jetties.

PILE - A long, heavy timber or section of concrete or metal to be driven or jetted into the earth or seabed to serve as a support or protection.

PILE, SHEET - A pile with a generally slender flat cross section to be driven into the ground or seabed and meshed or interlocked with like members to form a diaphragm, wall, or bulkhead.

PILING - A group of piles.

PLAIN, COASTAL - See COASTAL PLAIN.

PLANFORM - The outline or shape of a body of water as determined by the stillwater line.

PLATEAU - A land area (usually extensive) having a relatively level surface raised sharply above adjacent land on at least one side; table land. A similar undersea feature.

PLUNGE POINT - (1) For a plunging wave, the point at which the wave curls over and falls. (2) The final breaking point of the waves just before they rush up on the beach. (See Figure A-1.)

PLUNGING BREAKER - See BREAKER.

POCKET BEACH - A beach, usually small, in a coastal reentrant or between two littoral barriers.

POINT - The extreme end of a cape, or the outer end of any land area protruding into the water, usually less prominent than a cape.

PORT - A place where vessels may discharge or receive cargo; may be the entire harbor including its approaches and anchorages, or may be the commercial part of a harbor where the quays, wharves, facilities for transfer of cargo, docks, and repair shops are situated.

POTENTIAL ENERGY OF WAVES - In a progressive oscillatory wave, the energy resulting from the elevation or depression of the water surface from the undisturbed level.

PRISM - See TIDAL PRISM.

PROBABLE MAXIMUM WATER LEVEL - A hypothetical water level (exclusive of wave runup from normal wind-generated waves) that might result from the most severe combination of hydrometeorological, geoseismic and other geophysical factors that is considered reasonably possible in the region involved, with each of these factors considered as affecting the locality in a maximum manner.

This level represents the physical response of a body of water to maximum applied phenomena such as hurricanes, moving squall lines, other cyclonic meteorological events, tsunamis, and astronomical tide combined with maximum probable ambient hydrological conditions such as wave setup, rainfall, runoff, and river flow. It is a water level with virtually no risk of being exceeded.

PROFILE, BEACH - The intersection of the ground surface with a vertical plane; may extend from the top of the dune line to the seaward limit of sand movement. (See Figure A-1.)

PROGRESSION (of a beach) - See ADVANCE.

PROGRESSIVE WAVE - A wave that moves relative to a fixed coordinate system in a fluid. The direction in which it moves is termed the direction of wave propagation.

PROMONTORY - A high point of land projecting into a body of water; a HEADLAND.

PROPAGATION OF WAVES - The transmission of waves through water.

PROTOTYPE - In laboratory usage, the full-scale structure, concept, or phenomenon used as a basis for constructing a scale model or copy.

QUAY (Pronounced KEY) - A stretch of paved bank, or a solid artificial landing place parallel to the navigable waterway, for use in loading and unloading vessels.

QUICKSAND - Loose, yielding, wet sand which offers no support to heavy objects. The upward flow of the water has a velocity that eliminates contact pressures between the sand grains, and causes the sand-water mass to behave like a fluid.

RADIUS OF MAXIMUM WINDS - Distance from the eye of a hurricane, where surface and wind velocities are zero to the place where surface wind speeds are maximum.

RAY, WAVE - See ORTHOGONAL.

RECESSION (of a beach) - (1) A continuing landward movement of the shoreline. (2) A net landward movement of the shoreline over a specified time. Also RETROGRESSION.

REEF - An offshore consolidated rock hazard to navigation with a least depth of 10 fathoms (about 20 meters) or less.

REEF, ATOLL - See ATOLL.

REEF, BARRIER - See BARRIER REEF.

REEF, FRINGING - See FRINGING REEF.

REEF, SAND - Synonymous with BAR.

REFERENCE PLANE - See DATUM PLANE.

REFERENCE STATION - A place for which tidal constants have previously been determined and which is used as a standard for the comparison of simultaneous observations at a second station; also a station for which independent daily predictions are given in the tide or current tables from which corresponding predictions are obtained for other stations by means of differences or factors.

REFLECTED WAVE - That part of an incident wave that is returned seaward when a wave impinges on a steep beach, barrier, or other reflecting surface.

REFRACTION (OF WATER WAVES) - (1) The process by which the direction of a wave moving in shallow water at an angle to the contours is changed. The part of the wave advancing in shallower water moves more slowly than that part still advancing in deeper water, causing the wave crest to bend toward alignment with the underwater contours. (2) The bending of wave crests by currents. (See Figure A-5.)

REFRACTION COEFFICIENT - The square root of the ratio of the spacing between adjacent orthogonals in deep water and in shallow water at a selected point. When multiplied by the SHOALING FACTOR and a factor for friction and percolation, this becomes the WAVE HEIGHT COEFFICIENT or the ratio of the refracted wave height at any point to the deepwater wave height. Also the square root of the ENERGY COEFFICIENT.

REFRACTION DIAGRAM - A drawing showing positions of wave crests and/or orthogonals in a given area for a specific deepwater wave period and direction. (See Figure A-6.)

RESONANCE - The phenomenon of amplification of a free wave or oscillation of a system by a forced wave or oscillation of exactly equal period. The forced wave may arise from an impressed force upon the system or from a boundary condition.

RETARDATION - The amount of time by which corresponding tidal phases grow later day by day (about 50 minutes).

RETROGRESSION OF A BEACH - (1) A continuing landward movement of the shoreline. (2) A net landward movement of the shoreline over a specified time. Also RECESSION.

REVETMENT - A facing of stone, concrete, etc., built to protect a scarp, embankment, or shore structure against erosion by wave action or currents.

REYNOLDS NUMBER - The dimensionless ratio of the inertial force to the viscous force in fluid motion,

$$Re = \frac{LV}{\nu}$$

where L is a characteristic length, ν the kinematic viscosity, and V a characteristic velocity. The Reynolds number is of importance in the theory of hydrodynamic stability and the origin of turbulence.

RIA - A long, narrow inlet, with depth gradually diminishing inward.

RIDGE, BEACH - A nearly continuous mound of beach material that has been shaped up by wave or other action. Ridges may occur singly or as a series of approximately parallel deposits. (See Figure A-7.) British usage, fulls.

RILL MARKS - Tiny drainage channels in a beach caused by the flow seaward of water left in the sands of the upper part of the beach after the retreat of the tide or after the dying down of storm waves.

RIP - A body of water made rough by waves meeting an opposing current, particularly a tidal current; often found where tidal currents are converging and sinking.

RIPARIAN - Pertaining to the banks of a body of water.

RIPARIAN RIGHTS - The rights of a person owning land containing or bordering on a water course or other body of water in or to its banks, bed, or waters.

RIP CURRENT - A strong surface current flowing seaward from the shore. It usually appears as a visible band of agitated water and is the return movement of water piled up on the shore by incoming waves and wind. With the seaward movement concentrated in a limited band its velocity is somewhat accentuated. A rip consists of three parts: the FEEDER CURRENTS flowing parallel to the shore inside the breakers; the NECK, where the feeder currents converge and flow through the breakers in a narrow band or "rip"; and the HEAD, where the current widens and slackens outside the breaker line. A rip current is often miscalled a rip tide. Also RIP SURF. See NEARSHORE CURRENT SYSTEM. (See Figure A-7.)

RIP SURF - See RIP CURRENT.

RIPPLE - (1) The ruffling of the surface of water, hence a little curling wave or undulation. (2) A wave less than 2 inches long controlled to a significant degree by both surface tension and gravity. See WAVE, CAPILLARY and WAVE, GRAVITY.

RIPPLES (BED FORMS) - Small bed forms with wavelengths less than 1 foot and heights less than 0.1 foot.

RIPRAP - A layer, facing, or protective mound of stones randomly placed to prevent erosion, scour, or sloughing of a structure or embank- also the stone so used.

ROADSTEAD (Nautical) - A sheltered area of water near shore where vessels may anchor in relative safety. Also road.

ROLLER - An indefinite term, sometimes considered to denote one of a series of long-crested, large waves which roll in on a shore, as after a storm.

RUBBLE - (1) Loose angular waterworn stones along a beach. (2) Rough, irregular fragments of broken rock.

RUBBLE-MOUND STRUCTURE - A mound of random-shaped and random-placed stones protected with a cover layer of selected stones or specially shaped concrete armor units. (Armor units in primary cover layer may be placed in orderly manner or dumped at random.)

RUNNEL - A corrugation or trough formed in the foreshore or in the bottom just offshore by waves or tidal currents.

RUNUP - The rush of water up a structure or beach on the breaking of a wave. Also UPRUSH. The amount of runup is the vertical height above stillwater level that the rush of water reaches.

SALTATION - That method of sand movement in a fluid in which individual particles leave the bed by bounding nearly vertically and, because the motion of the fluid is not strong or turbulent enough to retain them in suspension, return to the bed at some distance downstream. The travel path of the particles is a series of hops and bounds.

SALT MARSH - A marsh periodically flooded by salt water.

SAND - See SOIL CLASSIFICATION.

SANDBAR - (1) See BAR. (2) In a river, a ridge of sand built up to or near the surface by river currents.

SAND BYPASSING - See BYPASSING, SAND.

SAND REEF - Synonymous with BAR.

SAND WAVE (or MEGARIPPLE) - A large wavelike sediment feature composed of sand in very shallow water. Wavelength may reach 100 meters; amplitude is about 0.5 meters.

SCARP - See ESCARPMENT.

SCARP, BEACH - An almost vertical slope along the beach caused by erosion by wave action. It may vary in height from a few inches to several feet, depending on wave action and the nature and composition of the beach. (See Figure A-1.)

SCOUR - Removal of underwater material by waves and currents, especially at the base or toe of a shore structure.

SEAS - Waves caused by wind at the place and time of observation.

SEA STATE - Description of the sea surface with regard to wave action. Also called state of sea.

SEA BREEZE - A light wind blowing from the sea toward the land caused by unequal heating of land and water masses.

SEA CLIFF - A cliff situated at the seaward edge of the coast.

SEA LEVEL - See MEAN SEA LEVEL.

SEAMOUNT - An elevation rising more than 1,000 meters above the ocean floor, and of limited extent across the summit.

SEA PUSS - A dangerous longshore current; a rip current caused by return flow; loosely, the submerged channel or inlet through a bar caused by those currents.

SEASHORE - The SHORE of a sea or ocean.

SEAWALL - A structure separating land and water areas, primarily designed to prevent erosion and other damage due to wave action. See also BULKHEAD.

SEICHE - (1) A standing wave oscillation of an enclosed water body that continues, pendulum fashion, after the cessation of the originating force, which may have been either seismic or atmospheric. (2) An oscillation of a fluid body in response to a disturbing force having the same frequency as the natural frequency of the fluid system. Tides are now considered to be seiches induced primarily by the periodic forces caused by the sun and moon. (3) In the Great Lakes area, any sudden rise in the water of a harbor or a lake whether or not it is oscillatory. Although inaccurate in a strict sense, this usage is well established in the Great Lakes area.

SEISMIC SEA WAVE (TSUNAMI) - A long-period wave caused by an underwater seismic disturbance or volcanic eruption. Commonly misnamed "tidal wave".

SEMIDIURNAL TIDE - A tide with two high and two low waters in a tidal day with comparatively little diurnal inequality (See Figure A-10.)

SET OF CURRENT - The direction toward which a current flows.

SETUP, WAVE - Superelevation of the water surface over normal surge elevation due to onshore mass transport of the water by wave action alone.

SETUP, WIND - See WIND SETUP.

SHALLOW WATER - (1) Commonly, water of such a depth that surface waves are noticeably affected by bottom topography. It is customary to consider water of depths less than one-half the surface wavelength as shallow water. See TRANSITIONAL ZONE and DEEP WATER. (2) More strictly, in hydrodynamics with regard to progressive gravity waves, water in which the depth is less than 1/25 the wavelength. Also called VERY SHALLOW WATER.

SHEET PILE - See PILE, SHEET.

SHELF, CONTINENTAL - See CONTINENTAL SHELF

SHELF, INSULAR - See INSULAR SHELF

SHINGLE - (1) Loosely and commonly, any beach material coarser than ordinary gravel, especially any having flat or flattish pebbles. (2) Strictly and accurately, beach material of smooth, well-rounded pebbles that are roughly the same size. The spaces between pebbles are not filled with finer materials. Shingle often gives out a musical sound when stepped on.

SHOAL (noun) - A detached elevation of the sea bottom, comprised of any material except rock or coral, which may endanger surface navigation.

SHOAL (verb) - (1) To *become* shallow gradually. (2) To *cause* to become shallow. (3) To *proceed* from a greater to a lesser depth of water.

SHOALING COEFFICIENT - The ratio of the height of a wave in water of any depth to its height in deep water with the effects of refraction, friction, and percolation eliminated. Sometimes SHOALING FACTOR or DEPTH FACTOR. See also ENERGY COEFFICIENT and REFRACTION COEFFICIENT.

SHORE - The narrow strip of land in immediate contact with the sea, including the zone between high and low water lines. A shore of unconsolidated material is usually called a beach. (See Figure A-1.)

SHOREFACE - The narrow zone seaward from the low tide SHORELINE covered by water over which the beach sands and gravels actively oscillate with changing wave conditions. See INSHORE (ZONE) and Figure A-1.

SHORELINE - The intersection of a specified plane of water with the shore or beach. (e.g., the highwater shoreline would be the intersection of the plane of mean high water with the shore or beach.) The line delineating the shoreline on U. S. Coast and Geodetic Survey nautical charts and surveys approximates the mean high water line.

SIGNIFICANT WAVE - A statistical term relating to the one-third highest waves of a given wave group and defined by the average of their heights and periods. The composition of the higher waves depends upon the extent to which the lower waves are considered. Experience indicates that a careful observer who attempts to establish the character of the higher waves will record values which approximately fit the definition of the significant wave.

SIGNIFICANT WAVE HEIGHT - The average height of the one-third highest waves of a given wave group. Note that the composition of the highest waves depends upon the extent to which the lower waves are considered. In wave record analysis, the average height of the highest one-third of a selected number of waves, this number being determined by dividing the time of record by the significant period. Also CHARACTERISTIC WAVE HEIGHT.

SIGNIFICANT WAVE PERIOD - An arbitrary period generally taken as the period of the one-third highest waves within a given group. Note that the composition of the highest waves depends upon the extent to which the lower waves are considered. In wave record analysis, this is determined as the average period of the most frequently recurring of larger well-defined waves in the record under study.

SILT - See SOIL CLASSIFICATION.

SINUSOIDAL WAVE - An oscillatory wave having the form of a sinusoid.

SLACK TIDE (SLACK WATER) - The state of a tidal current when its velocity is near zero, especially the moment when a reversing current changes direction and its velocity is zero. Sometimes considered the intermediate period between ebb and flood currents during which the velocity of the currents is less than 0.1 knot. See STAND OF TIDE.

SLIP - A berthing space between two piers.

SLOPE - The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating 1 unit vertical rise in 25 units of horizontal distance; or in a decimal fraction (0.04); degrees (2° 18'); or percent (4%).

SLOUGH - See BAYOU.

SOIL CLASSIFICATION (size) - An arbitrary division of a continuous scale of grain sizes such that each scale unit or grade may serve as a convenient class interval for conducting the analysis or for expressing the results of an analysis. There are many classifications used, the two most often used are shown graphically on the next page.

SOLITARY WAVE - A wave consisting of a single elevation (above the original water surface), its height not necessarily small compared to the depth, and neither followed nor preceded by another elevation or depression of the water surfaces.

SORTING COEFFICIENT - A coefficient used in describing the distribution of grain sizes in a sample of unconsolidated material. It is defined as $S_0 = \sqrt{Q_1/Q_3}$, where Q_1 is the diameter (in millimeters) which has 75 percent of the cumulative size-frequency (by weight) distribution smaller than itself and 25 percent larger than itself, and Q_3 is that diameter having 25 percent smaller and 75 percent larger than itself.

SOUND (noun) - (1) A wide waterway between the mainland and an island, or a wide waterway connecting two sea areas. See also STRAIT. (2) A relatively long arm of the sea or ocean forming a channel between an island and a mainland or connecting two larger bodies, as a sea and the ocean, or two parts of the same body; usually wider and more extensive than a strait.

SOUND (verb) - To measure the depth of the water.

SOUNDING - A measured depth of water. On hydrographic charts the soundings are adjusted to a specific plane of reference (SOUNDING DATUM).

SOUNDING DATUM - The plane to which soundings are referred. See also CHART DATUM.

GRAIN SIZE SCALES
(Soil Classification)

Wentworth Scale (Size Description)		Phi Units ϕ *	Grain Diameter, D (mm)	U.S. Std. Sieve Size	Unified Soil Classification (USC)	
Boulder		-8	256		Cobble	
Cobble			76.2	3"		
		-6	64.0		Coarse	Gravel
Pebble			19.0	3/4"	Fine	
			4.76	No. 4	Coarse	Sand
Granule		-2	4.0			
Sand	Very Coarse	-1	2.0	No. 10	Medium	
	Coarse	0	1.0			
	Medium	1	0.5			
			0.42	No. 40	Fine	
	Fine	2	0.25			
	Very Fine	3	0.125			
			0.074	No. 200		
Silt		4	0.0625		Silt or Clay	
Clay		8	0.00391			
Colloid		12	0.00024			

* $\phi = -\log_2 D$ (mm)

SOUNDING LINE - A line, wire, or cord used in sounding. It is weighted at one end with a plummet (sounding lead). Also LEADLINE.

SPILLING BREAKER - See BREAKER.

SPIT - A small point of land or a narrow shoal projecting into a body of water from the shore. (See Figure A-9.)

SPRING TIDE - A tide that occurs at or near the time of new or full moon (syzygy), and which rises highest and falls lowest from the mean sea level.

STANDARD PROJECT HURRICANE - See HYPOTHETICAL HURRICANE.

STAND OF TIDE - An interval at high or low water when there is no sensible change in the height of the tide. The water level is stationary at high and low water for only an instant, but the change in level near these times is so slow that it is not usually perceptible. See SLACK TIDE.

STANDING WAVE - A type of wave in which the surface of the water oscillates vertically between fixed points, called nodes, without progression. The points of maximum vertical rise and fall are called antinodes or loops. At the nodes, the underlying water particles exhibit no vertical motion, but maximum horizontal motion. At the antinodes, the underlying water particles have no horizontal motion but maximum vertical motion. They may be the result of two equal progressive wave trains traveling through each other in opposite directions. Sometimes called CLAPOTIS or STATIONARY WAVE.

STATIONARY WAVE - A wave of essentially stable form which does not move with respect to a selected reference point; a fixed swelling. Sometimes called STANDING WAVE.

STILLWATER LEVEL - The elevation that the surface of the water would assume if all wave action were absent.

STOCKPILE - Sand piled on a beach foreshore to nourish downdrift beaches by natural littoral currents or forces. See FEEDER BEACH.

STONE, DERRICK - Stone heavy enough to require handling individual pieces by mechanical means, generally 1 ton and up.

STORM SURGE - A rise above normal water level on the open coast due to the action of wind stress on the water surface. Storm surge resulting from a hurricane also includes that rise in level due to atmospheric pressure reduction as well as that due to wind stress. See WIND SETUP.

STORM TIDE - See STORM SURGE.

STRAIT - A relatively narrow waterway between two larger bodies of water. See also SOUND.

STREAM - (1) A course of water flowing along a bed in the earth. (2) A current in the sea formed by wind action, water density differences, etc. (Gulf Stream). See also CURRENT, STREAM.

SURF - The wave activity in the area between the shoreline and the outermost limit of breakers.

SURF BEAT - Irregular oscillations of the nearshore water level, with periods of the order of several minutes.

SURF ZONE - The area between the outermost breakers and the limit of wave uprush. (See Figures A-2 and A-5.)

SURGE - (1) The name applied to wave motion with a period intermediate between that of the ordinary wind wave and that of the tide, say from 1/2 to 60 minutes. It is of short height; usually less than 0.3 foot. See also SEICHE. (2) In fluid flow, long interval variations in velocity and pressure, not necessarily periodic, perhaps even transient in nature. (3) See STORM SURGE.

SURGING BREAKER - See BREAKER.

SUSPENDED LOAD - (1) The material moving in suspension in a fluid, being kept up by the upward components of the turbulent currents or by colloidal suspension. (2) The material collected in or computed from samples collected with a suspended load sampler. (A suspended load sampler is a sampler which attempts to secure a sample of the water with its sediment load without separating the sediment from the water.) Where it is necessary to distinguish between the two meanings given above, the first one may be called the "true suspended load".

SWALE - The depression between two beach ridges.

SWASH - The rush of water up onto the beach face following the breaking of a wave. Also UPRUSH, RUNUP. (See Figure A-2.)

SWASH CHANNEL - (1) On the open shore, a channel cut by flowing water in its return to the parent body (e.g., a rip channel). (2) A secondary channel passing through or shoreward of an inlet or river bar. (See Figure A-9.)

SWASH MARK - The thin wavy line of fine sand, mica scales, bits of seaweed, etc., left by the uprush when it recedes from its upward limit of movement on the beach face.

SWELL - Wind-generated waves that have traveled out of their generating area. Swell characteristically exhibits a more regular and longer period, and has flatter crests than waves within their fetch (SEAS).

SYNOPTIC CHART - A chart showing the distribution of meterological conditions over a given area at a given time. Popularly called a weather map.

SYZYGY - The two points in the moon's orbit when the moon is in conjunction or opposition to the sun relative to the earth; time of new or full moon in the cycle of phases.

TERRACE - A horizontal or nearly horizontal natural or artificial topographic feature interrupting a steeper slope, sometimes occurring in a series.

THALWEG - In hydraulics, the line joining the deepest points of an inlet or stream channel.

TIDAL CURRENT - See CURRENT, TIDAL.

TIDAL DATUM - See CHART DATUM and DATUM PLANE.

TIDAL DAY - The time of the rotation of the earth with respect to the moon, or the interval between two successive upper transits of the moon over the meridian of a place, approximately 24.84 solar hours (24 hours and 50 minutes) or 1.035 times the mean solar day. (See Figure A-10.) Also called lunar day.

TIDAL FLATS - Marshy or muddy land areas which are covered and uncovered by the rise and fall of the tide.

TIDAL INLET - (1) A natural inlet maintained by tidal flow. (2) Loosely, any inlet in which the tide ebbs and flows. Also TIDAL OUTLET.

TIDAL PERIOD - The interval of time between two consecutive like phases of the tide. (See Figure A-10.)

TIDAL POOL - A pool of water remaining on a beach or reef after recession of the tide.

TIDAL PRISM - The total amount of water that flows into a harbor or estuary or out again with movement of the tide, excluding any freshwater flow.

TIDAL RANGE - The difference in height between consecutive high and low (or higher high and lower low) waters. (See Figure A-10.)

TIDAL RISE - The height of tide as referred to the datum of a chart. (See Figure A-10.)

TIDAL WAVE - (1) The wave motion of the tides. (2) In popular usage, any unusually high and destructive water level along a shore. It usually refers to STORM SURGE or TSUNAMI.

TIDE - The periodic rising and falling of the water that results from gravitational attraction of the moon and sun and other astronomical bodies acting upon the rotating earth. Although the accompanying horizontal movement of the water resulting from the same cause is also sometimes called the tide, it is preferable to designate the latter as TIDAL CURRENT, reserving the name TIDE for the vertical movement.

TIDE, DAILY RETARDATION OF - The amount of time by which corresponding tides grow later day by day (about 50 minutes).

TIDE, DIURNAL - A tide with one high water and one low water in a tidal day. (See Figure A-10)

TIDE, EBB - See EBB TIDE.

TIDE, FLOOD - See FLOOD TIDE.

TIDE, MIXED - See MIXED TIDE.

TIDE, NEAP - See NEAP TIDE.

TIDE, SEMIDIURNAL - See SEMIDIURNAL TIDE.

TIDE, SLACK - See SLACK TIDE.

TIDE, SPRING - See SPRING TIDE.

TIDE STATION - A place at which tide observations are being taken. It is called a *primary* tide station when continuous observations are to be taken over a number of years to obtain basic tidal data for the locality. A *secondary* tide station is one operated over a short period of time to obtain data for a specific purpose.

TIDE, STORM - See STORM SURGE.

TOMBOLO - A bar or spit that connects or "ties" an island to the mainland or to another island. (See Figure A-9.)

TOPOGRAPHY - The configuration of a surface, including its relief, the position of its streams, roads, building, etc.

TRAINING WALL - A wall or jetty to direct current flow.

TRANSITIONAL ZONE (TRANSITIONAL WATER) - In regard to progressive gravity waves, water whose depth is less than 1/2 but more than 1/25 the wave length. Often called SHALLOW WATER.

TRANSLATORY WAVE - See WAVE OF TRANSLATION.

TRANSPOSED HURRICANE - See HYPOTHETICAL HURRICANE.

TROCHOIDAL WAVE - A theoretical, progressive oscillatory wave first proposed by Gerstner in 1802 to describe the surface profile and particle orbits of finite amplitude, nonsinusoidal waves. The wave form is that of a prolate cycloid or trochoid, and the fluid particle motion is rotational as opposed to the usual irrotational particle motion for waves generated by normal forces. See IRROTATIONAL WAVE

TROPICAL CYCLONE - See HURRICANE

TROPICAL STORM - A tropical cyclone with maximum winds less than 75 mph.

TROUGH OF WAVE - The lowest part of a wave form between successive crests. Also that part of a wave below stillwater level. (See Figure A-3.)

TSUNAMI - A long-period wave caused by an underwater disturbance such as a volcanic eruption or earthquake. Commonly miscalled "tidal wave".

TYPHOON - See HURRICANE.

UNDERTOW - A seaward current near the bottom on a sloping inshore zone. It is caused by the return, under the action of gravity, of the water carried up on the shore by waves. Often a misnomer for RIP CURRENT.

UNDERWATER GRADIENT - The slope of the sea bottom. See also SLOPE.

UNDULATION - A continuously propagated motion to and fro, in any fluid or elastic medium, with no permanent translation of the particles themselves.

UPCOAST - In United States usage, the coastal direction generally trending toward the north.

UPDRIFT - The direction opposite that of the predominant movement of littoral materials.

UPLIFT - The upward water pressure on the base of a structure or pavement.

UPRUSH - The rush of water up onto the beach following the breaking of a wave. Also SWASH, RUNUP. (See Figure A-2.)

VALLEY, SEA - A submarine depression of broad valley form without the steep side slopes which characterize a canyon.

VALLEY, SUBMARINE - A prolongation of a land valley into or across a continental or insular shelf, which generally gives evidence of having been formed by stream erosion.

VARIABILITY OF WAVES - (1) The variation of heights and periods between individual waves within a wave train. (Wave trains are not composed of waves of equal height and period, but rather of heights and periods which vary in a statistical manner.) (2) The variation in direction of propagation of waves leaving the generating area. (3) The variation in height along the crest, usually called "variation along the wave".

VELOCITY OF WAVES - The speed at which an individual wave advances. See WAVE CELERITY.

VISCOSITY - (or internal friction) - That molecular property of a fluid that enables it to support tangential stresses for a finite time and thus to resist deformation.

WATERLINE - A juncture of land and sea. This line migrates, changing with the tide or other fluctuation in the water level. Where waves are present on the beach, this line is also known as the limit of backrush. (Approximately the intersection of the land with the stillwater level.)

WAVE - A ridge, deformation, or undulation of the surface of a liquid.

WAVE AGE - The ratio of wave speed to wind speed.

WAVE, CAPILLARY - See CAPILLARY WAVE.

WAVE CELERITY - Wave speed.

WAVE CREST - See CREST OF WAVE.

WAVE CREST LENGTH - See CREST LENGTH, WAVE.

WAVE, CYCLOIDAL - See CYCLOIDAL WAVE.

WAVE DECAY - See DECAY OF WAVES.

WAVE DIRECTION - The direction from which a wave approaches.

WAVE FORECASTING - The theoretical determination of future wave characteristics, usually from observed or predicted meteorological phenomena.

WAVE GENERATION - See GENERATION OF WAVES.

WAVE, GRAVITY - See GRAVITY WAVE.

WAVE GROUP - A series of waves in which the wave direction, wavelength, and wave height vary only slightly. See also GROUP VELOCITY.

WAVE HEIGHT - The vertical distance between a crest and the preceding trough. See also SIGNIFICANT WAVE HEIGHT. (See Figure A-3.)

WAVE HEIGHT COEFFICIENT - The ratio of the wave height at a selected point to the deepwater wave height. The refraction coefficient multiplied by the shoaling factor.

WAVE HINDCASTING - See HINDCASTING, WAVE.

WAVE, IRROTATIONAL - See IRROTATIONAL WAVE.

WAVELENGTH - The horizontal distance between similar points on two successive waves measured perpendicular to the crest. (See Figure A-3.)

WAVE, MONOCHROMATIC - See MONOCHROMATIC WAVE.

WAVE, OSCILLATORY - See OSCILLATORY WAVE.

WAVE PERIOD - The time for a wave crest to traverse a distance equal to one wave length. The time for two successive wave crests to pass a fixed point. See also SIGNIFICANT WAVE PERIOD.

WAVE, PROGRESSIVE - See PROGRESSIVE WAVE.

WAVE PROPAGATION - The transmission of waves through water.

WAVE RAY - See ORTHOGONAL.

WAVE, REFLECTED - That part of an incident wave that is returned seaward when a wave impinges on a steep beach, barrier, or other reflecting surface.

WAVE REFRACTION - See REFRACTION OF WATER WAVES.

WAVE SETUP - See SETUP, WAVE.

WAVE, SINUSOIDAL - An oscillatory wave having the form of a sinusoid.

WAVE, SOLITARY - See SOLITARY WAVE

WAVE, STANDING - See STANDING WAVE.

WAVE STEEPNESS - The ratio of the wave height to the wavelength.

WAVE TRAIN - A series of waves from the same direction.

WAVE OF TRANSLATION - A wave in which the water particles are permanently displaced to a significant degree in the direction of wave travel. Distinguished from an OSCILLATORY WAVE.

WAVE, TROCHOIDAL - See TROCHOIDAL WAVE.

WAVE TROUGH - The lowest part of a wave form between successive crests. Also that part of a wave below stillwater level.

WAVE VARIABILITY - See VARIABILITY OF WAVES.

WAVE VELOCITY - The speed at which an individual wave advances.

WAVE, WIND - See WIND WAVES.

WAVES, INTERNAL - See INTERNAL WAVES.

WEIR JETTY - An updrift jetty with a low section or weir over which littoral drift moves into a predredged deposition basin which is dredged periodically.

WHARF - A structure built on the shore of a harbor, river, or canal, so that vessels may lie alongside to receive and discharge cargo and passengers.

WHITECAP - On the crest of a wave, the white froth caused by wind.

WIND CHOP - See CHOP.

WIND, FOLLOWING - See FOLLOWING WIND.

WIND, OFFSHORE - A wind blowing seaward from the land in a coastal area.

WIND, ONSHORE - A wind blowing landward from the sea in a coastal area.

WIND, OPPOSING - See OPPOSING WIND.

WIND SETUP - (1) The vertical rise in the stillwater level on the leeward side of a body of water caused by wind stresses on the surface of the water. (2) The difference in stillwater levels on the windward and the leeward sides of a body of water caused by wind stresses on the surface of the water. (3) Synonymous with WIND TIDE and STORM SURGE. STORM SURGE is usually reserved for use on the ocean and large bodies of water. WIND SETUP is usually reserved for use on reservoirs and smaller bodies of water. (See Figure A-11.)

WIND TIDE - See WIND SETUP, STORM SURGE.

WINDWARD - The direction from which the wind is blowing.

WIND WAVES - (1) Waves being formed and built up by the wind. (2) Loosely, any wave generated by wind.

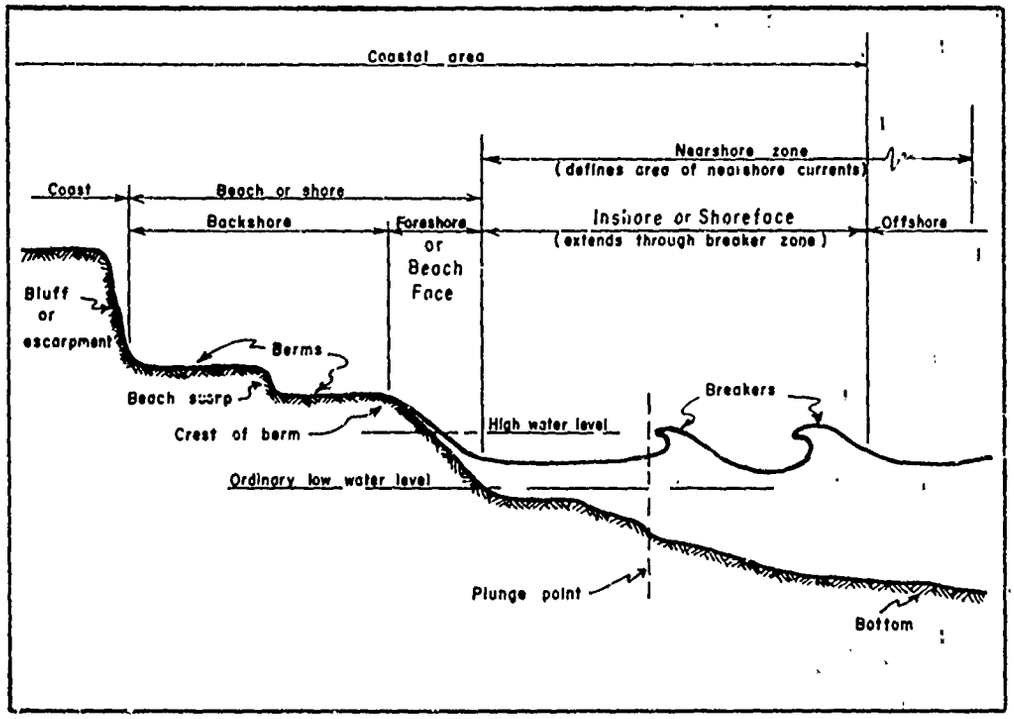


Figure A-1. Beach Profile-Related Terms.

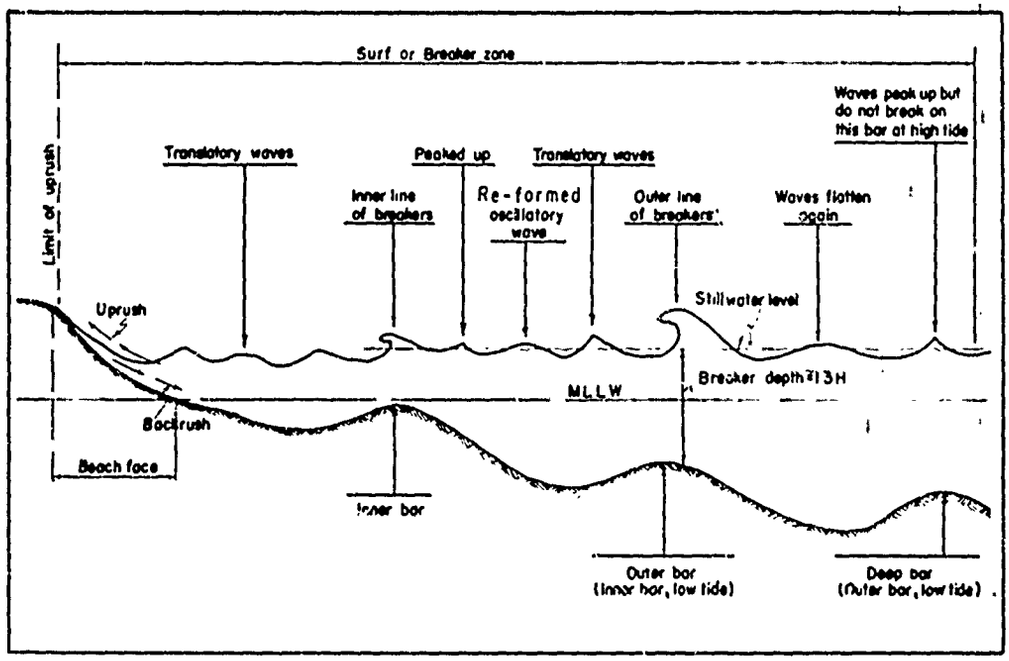


Figure A-2. Schematic Diagram of Waves in the Breaker Zone.

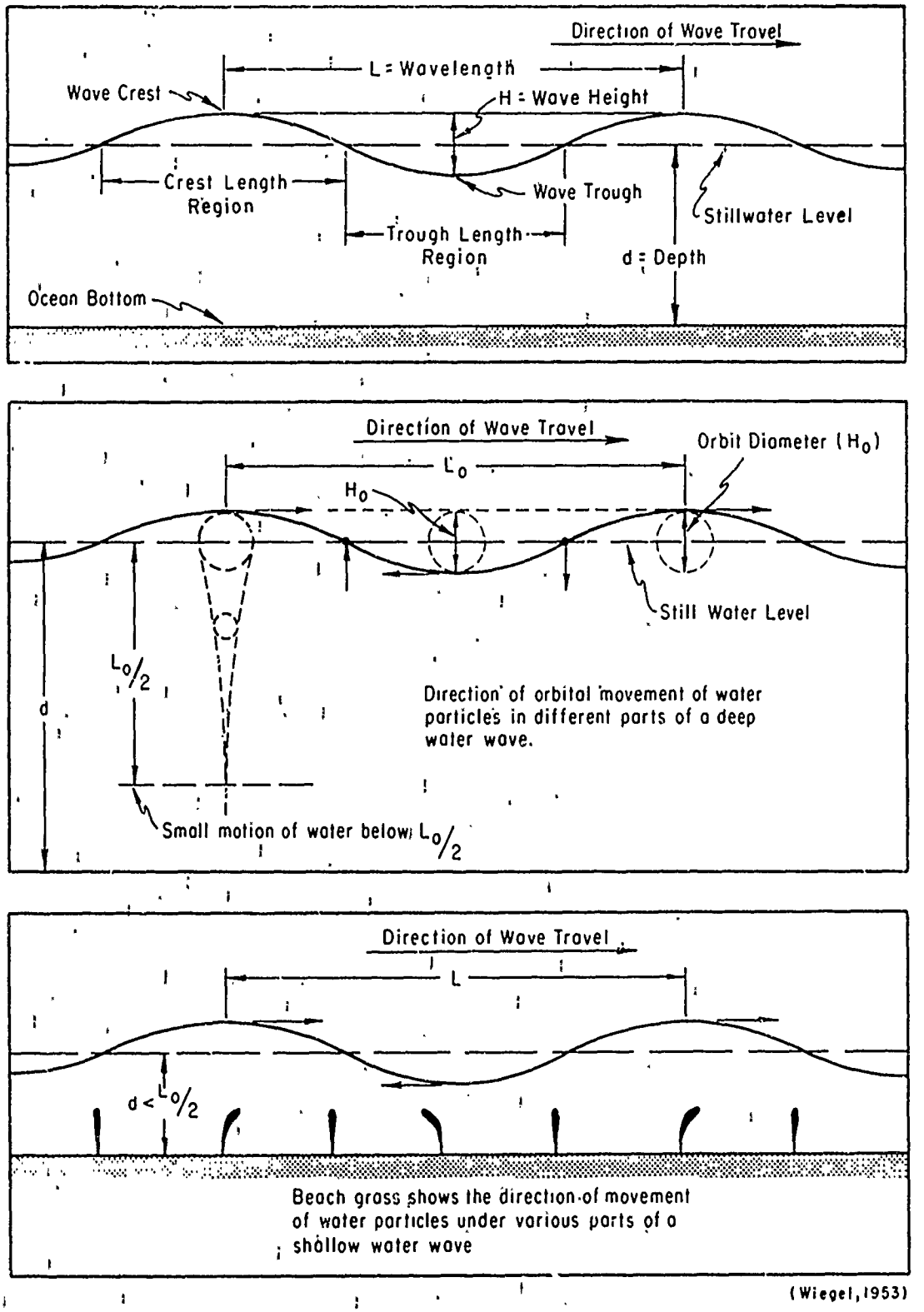
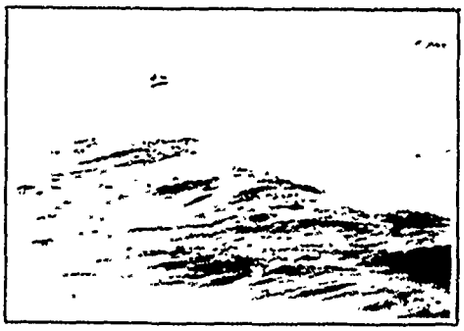
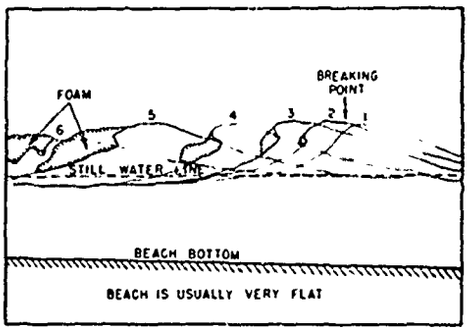


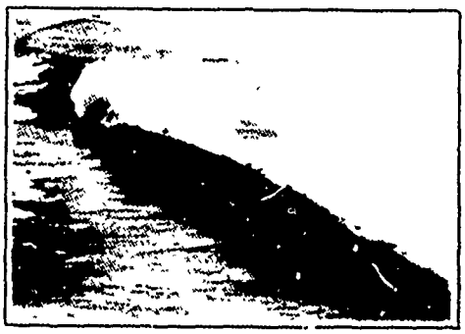
Figure A-3. Wave Characteristics and Direction of Water Particle Movement.



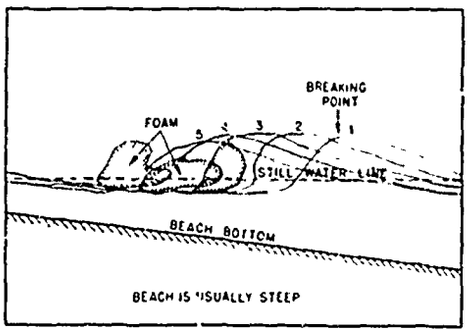
SPILLING BREAKER



SKETCH SHOWING THE GENERAL CHARACTER OF SPILLING BREAKERS

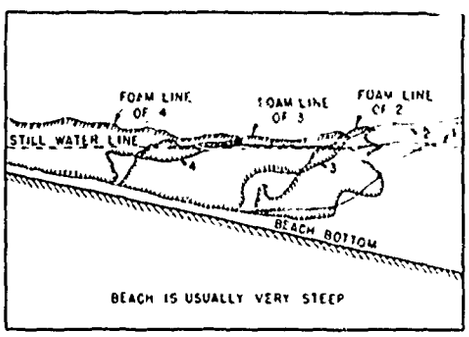


PLUNGING BREAKER



SKETCH SHOWING THE GENERAL CHARACTER OF PLUNGING BREAKERS

SURGING BREAKER



SKETCH SHOWING THE GENERAL CHARACTER OF SURGING BREAKERS

Both photographs and diagrams of the three types of breakers are presented above. The sketches consist of a series of profiles of the wave form as it appears before breaking, during breaking and after breaking. The numbers opposite the profile lines indicate the relative times of occurences.

(Wiegel,1953)

Figure A-4. Breaker Types.

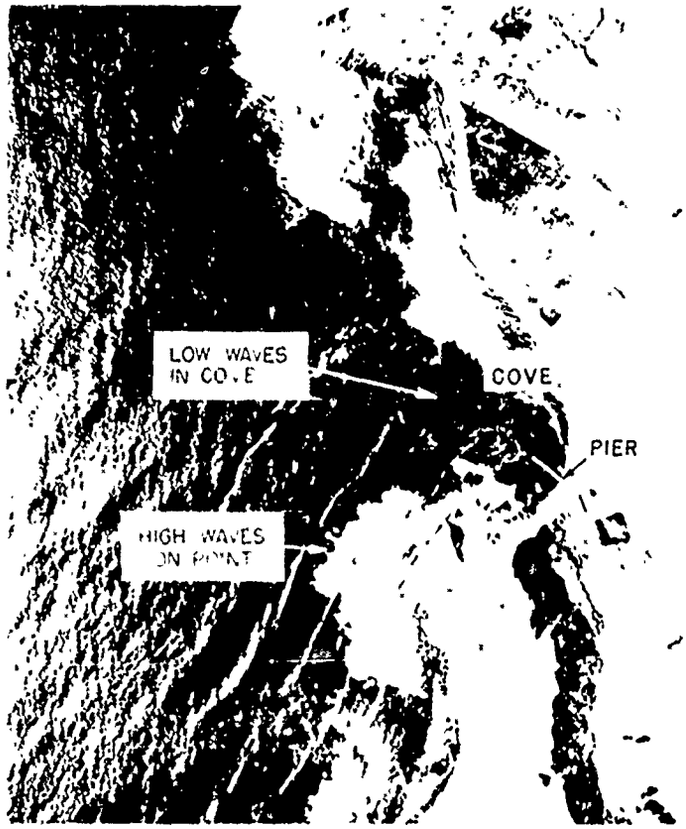
Pt. Pinos, California

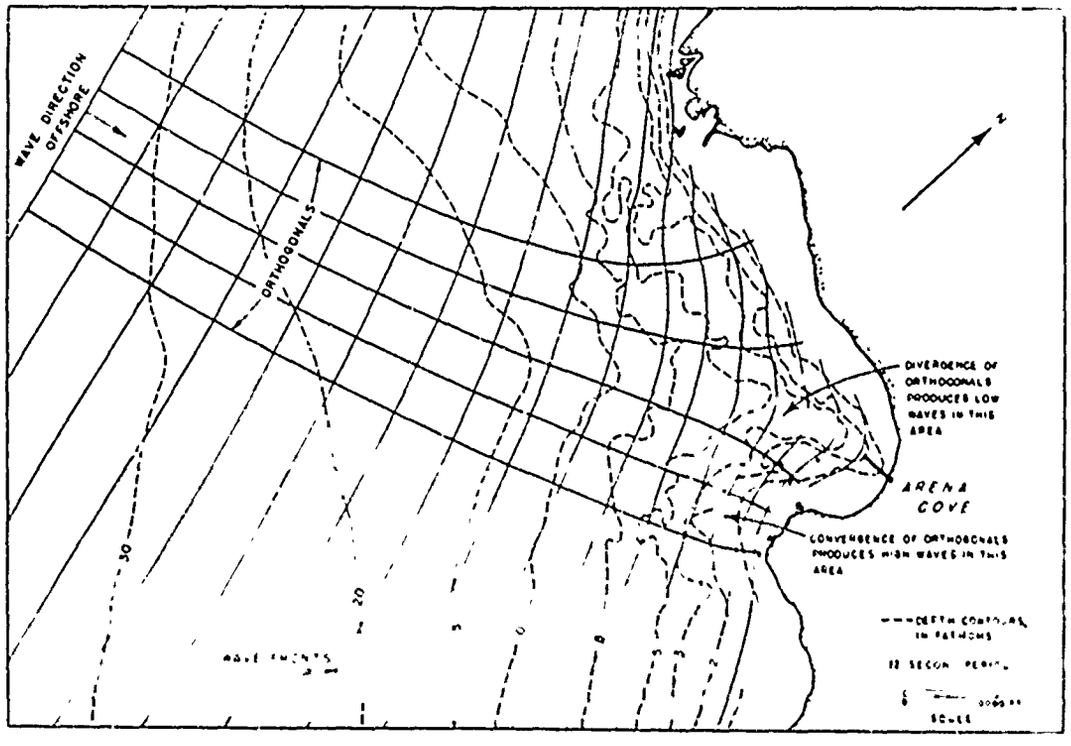
Waves moving over a submarine ridge concentrate to give large wave heights on a point

Half Moon Bay, California

(Wiegel, 1953)

Figure V-3. Refraction of Waves





(Wiegel, 1953)

Figure A-6. Refraction Diagram.

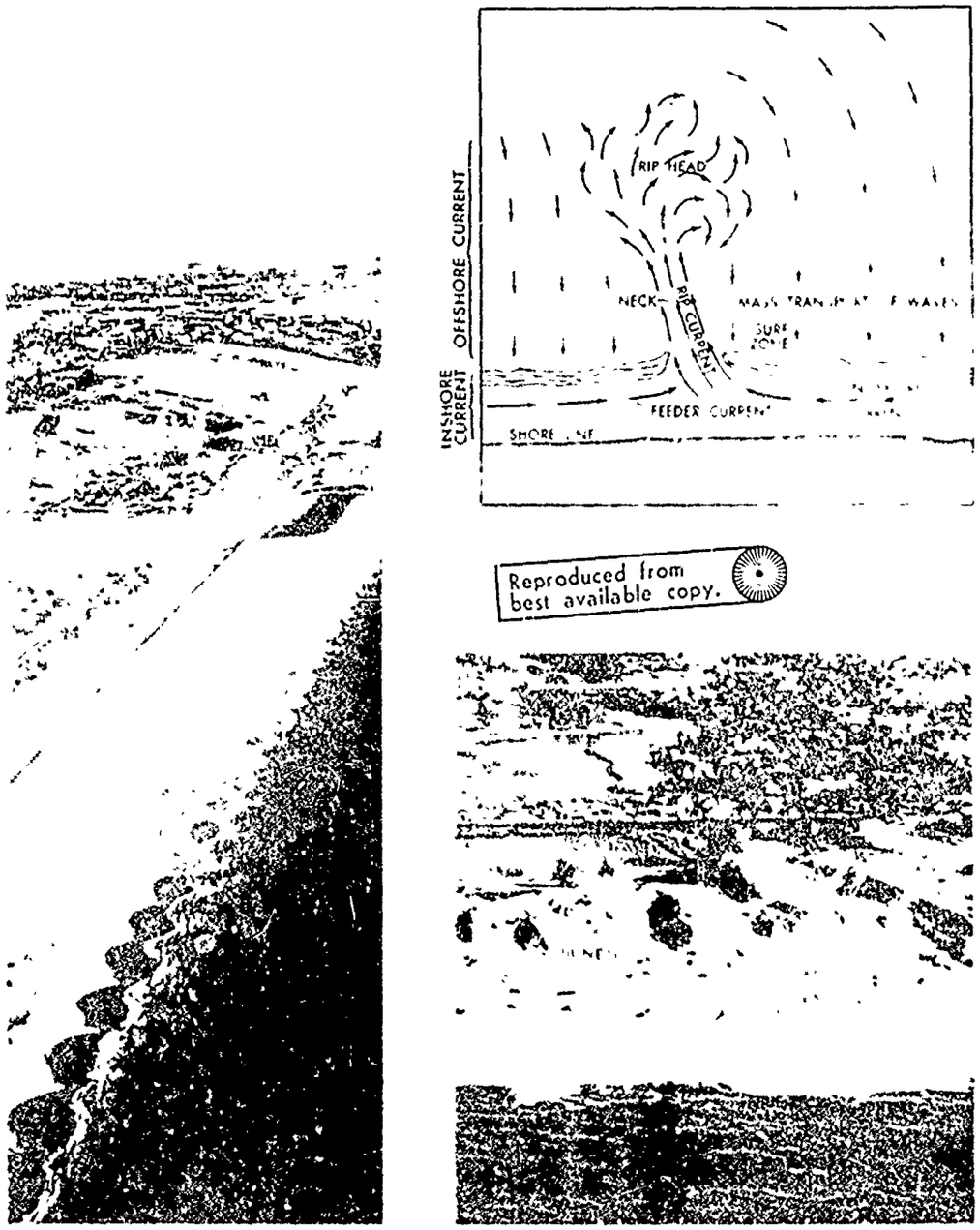


Figure V-7. Rip Current Features

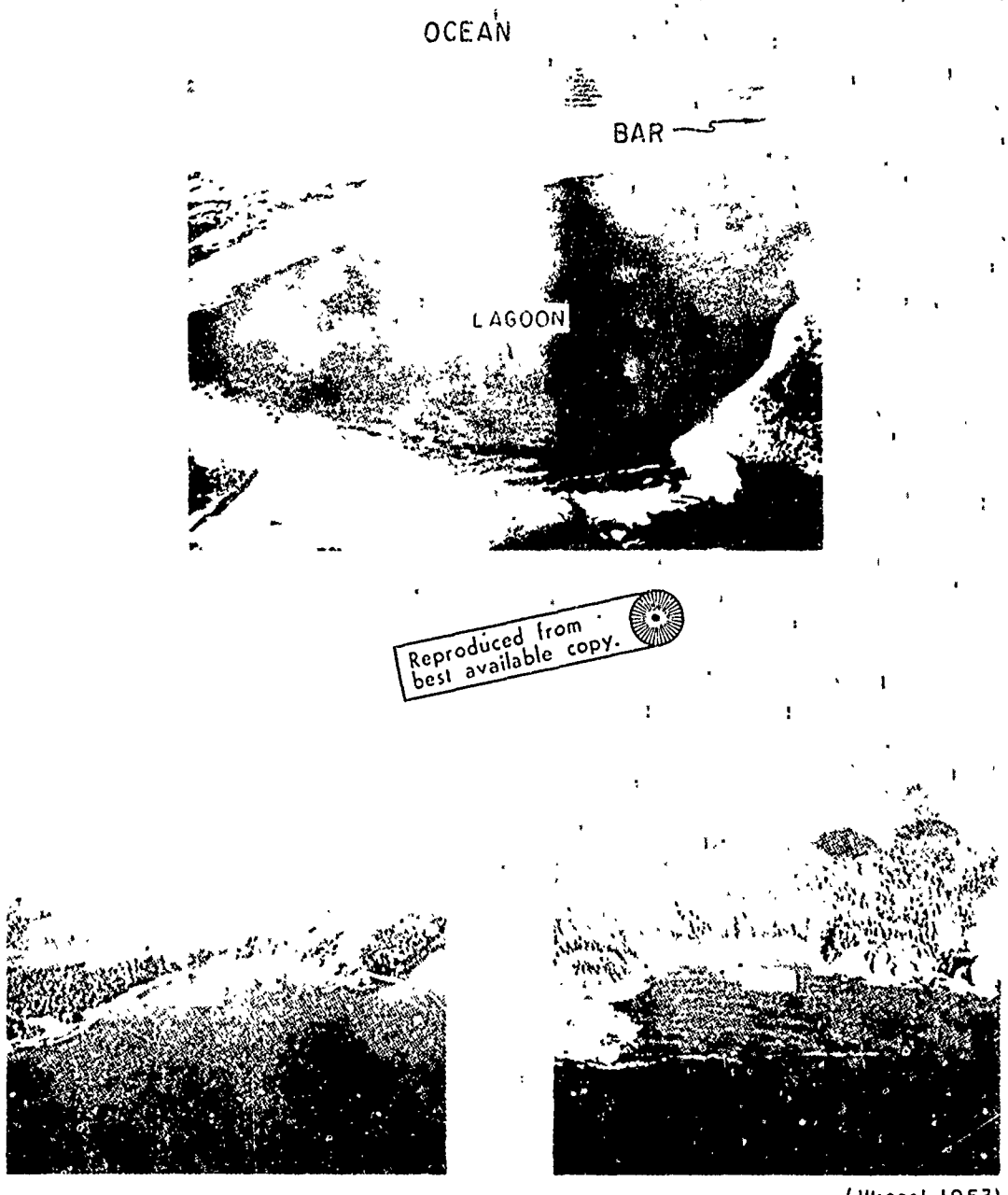


Figure A-8. Shoreline Features.

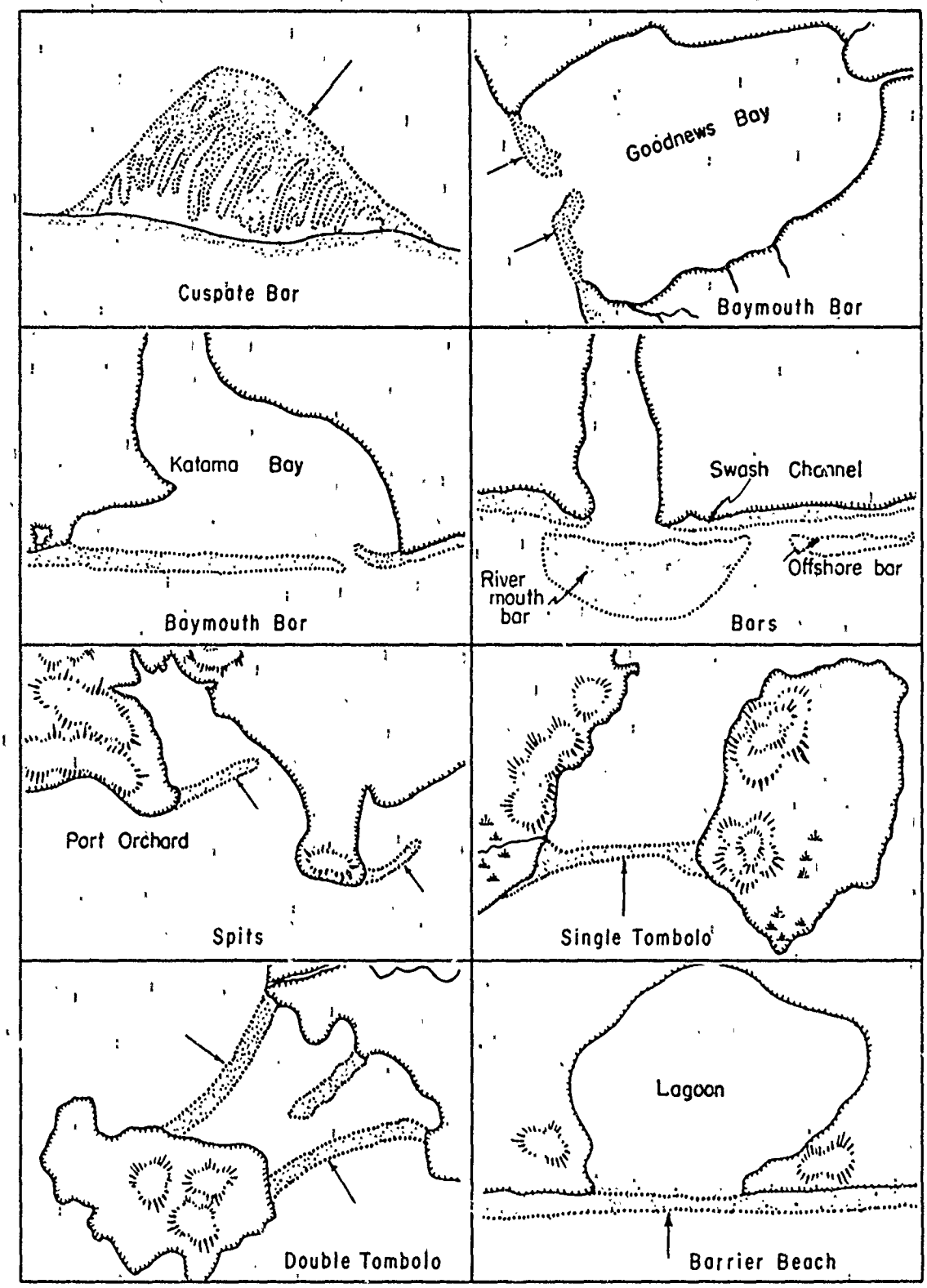


Figure A-9. Bar and Beach Forms. (from D. W. Johnson, Shore Process and Shoreline Development, 1919, published by John Wiley & Sons, Inc.)

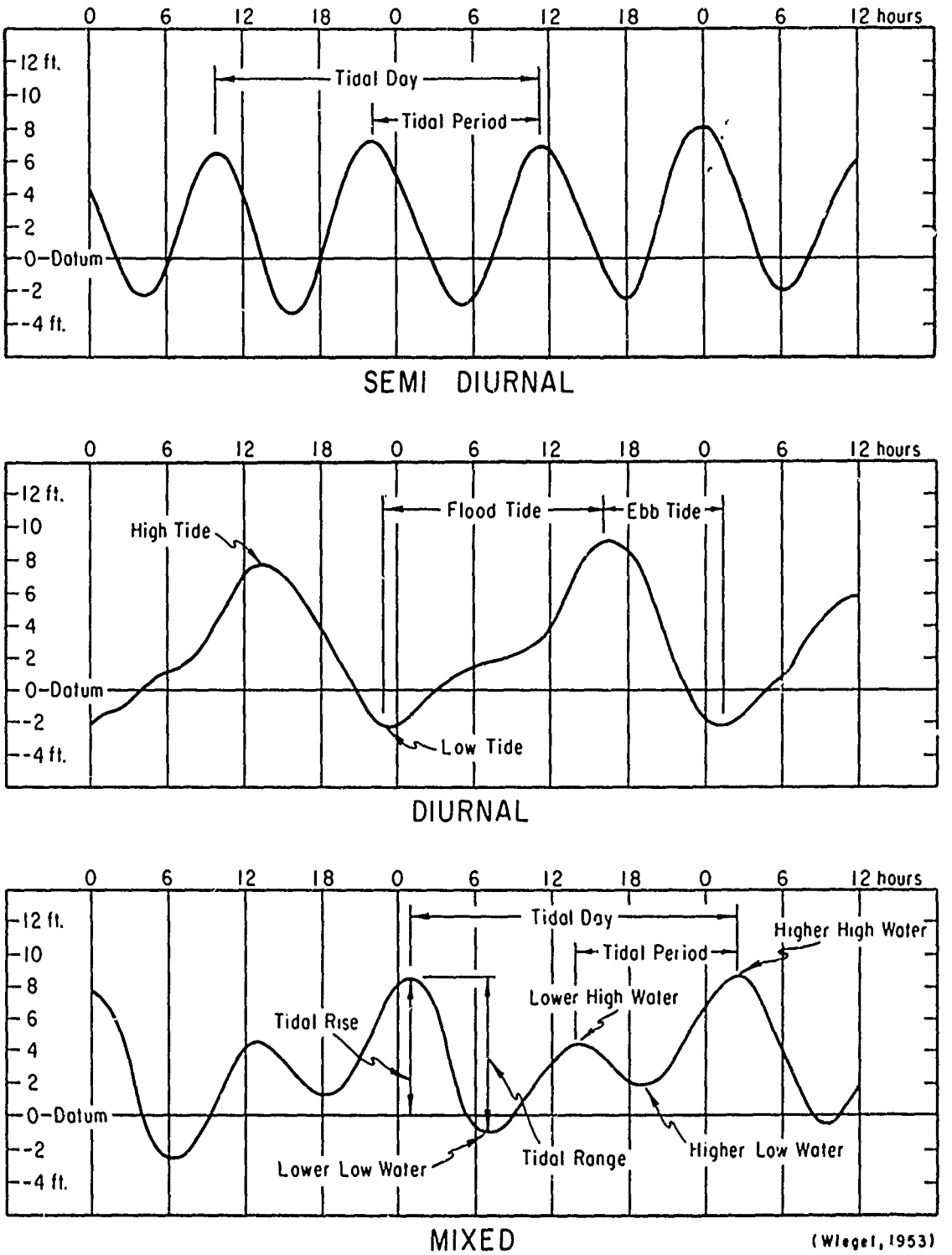


Figure A-10. Types of Tides.

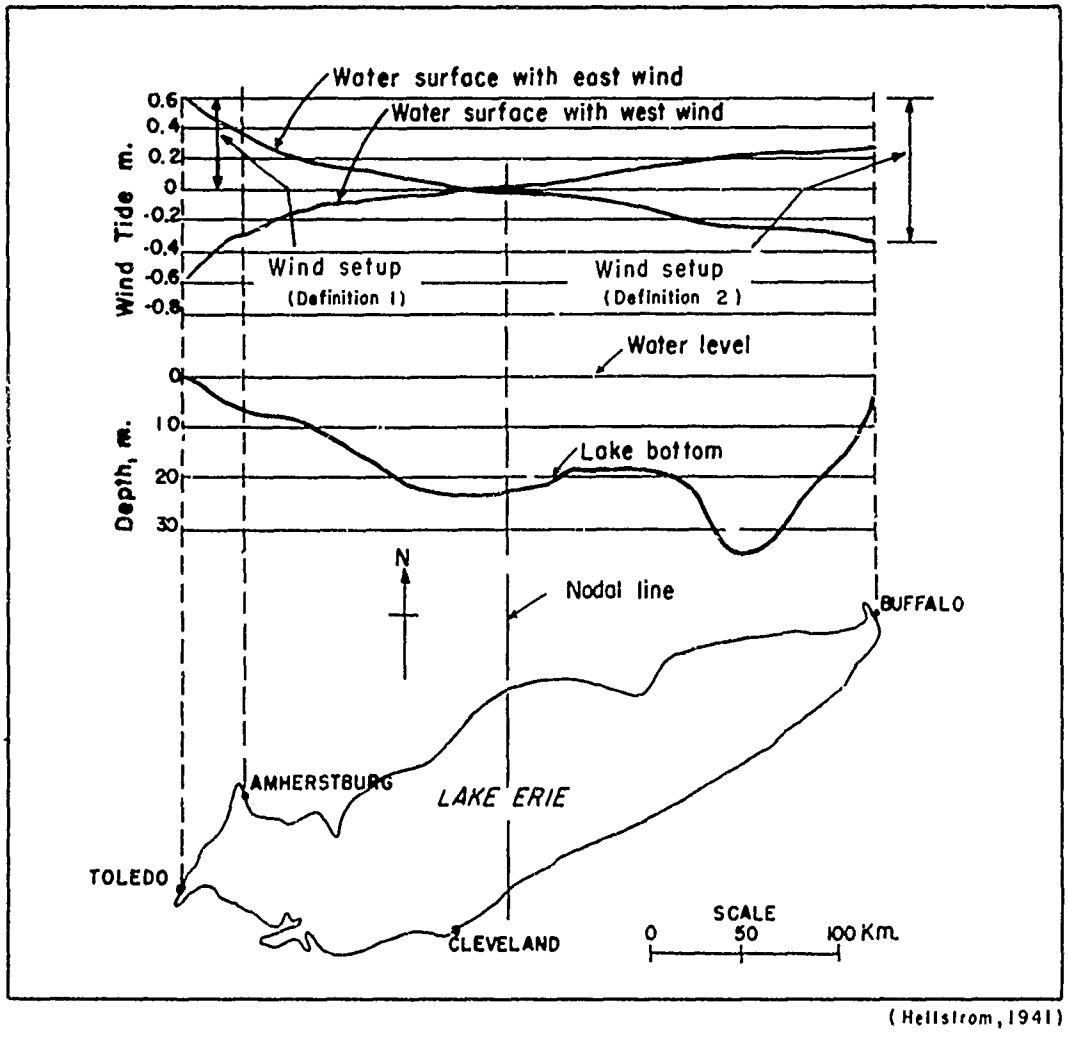
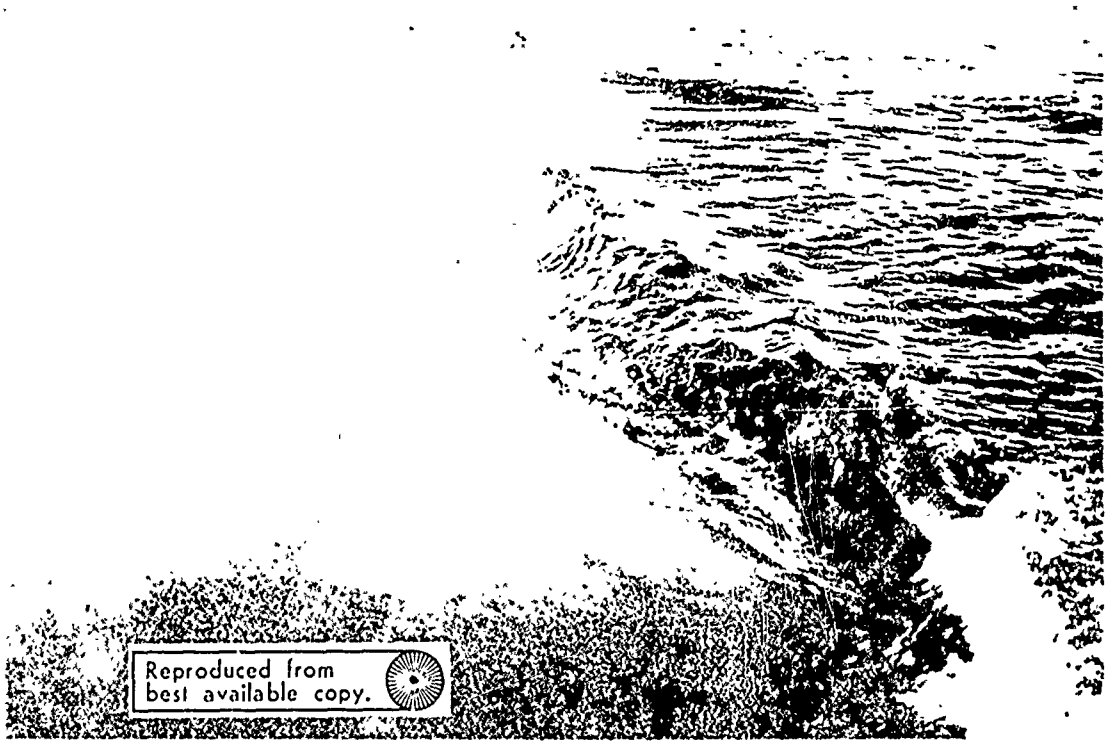


Figure A-11. Setup or Wind Tide.



[illegible] Fossil Plants.